MAPS 'Workfest' Report

Michael P. McCumber
Los Alamos National Laboratory

3rd sPHENIX Fortnightly General Meeting

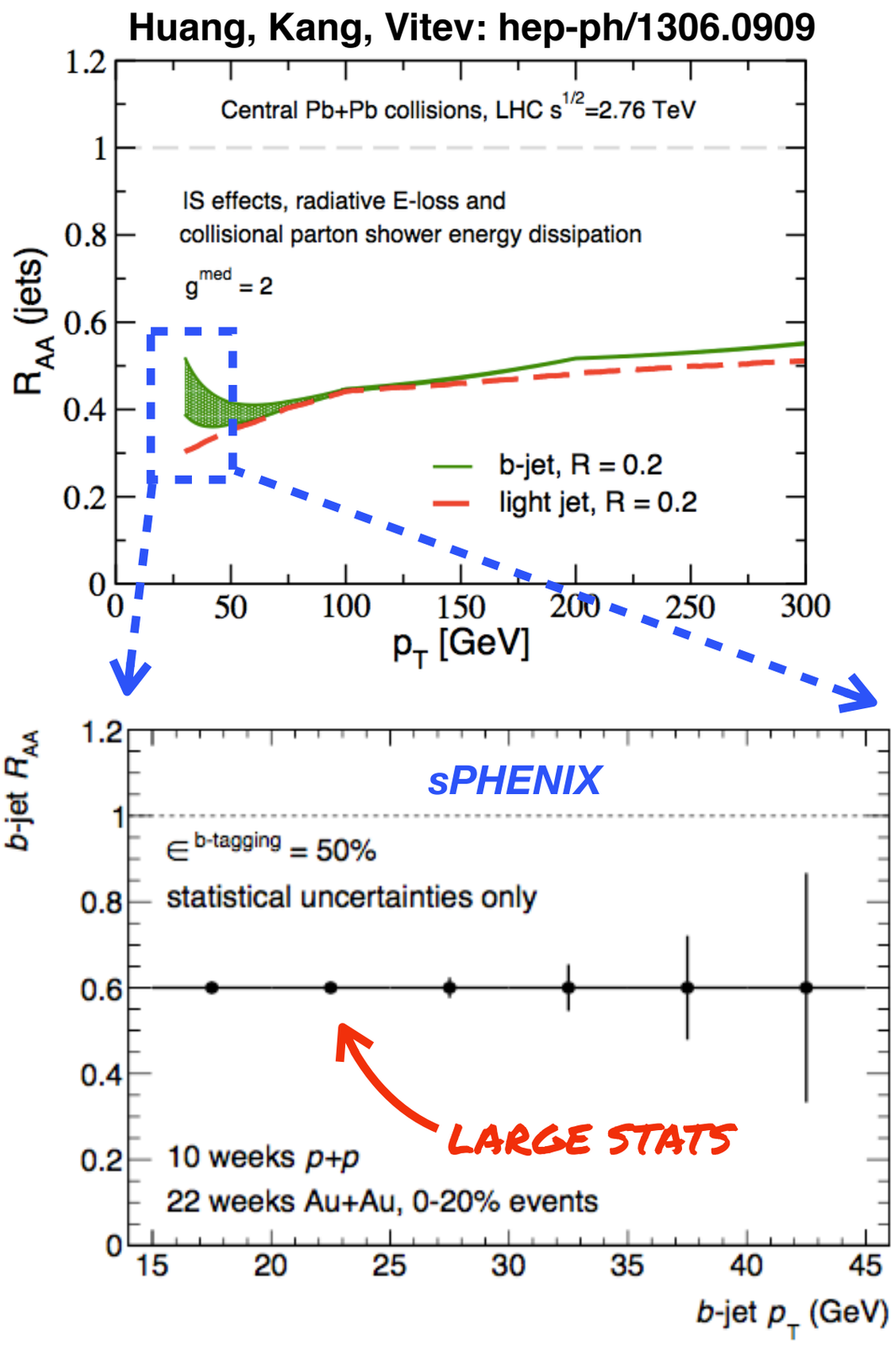
chaired by Gunther Roland (MIT), David Morrison (BNL)

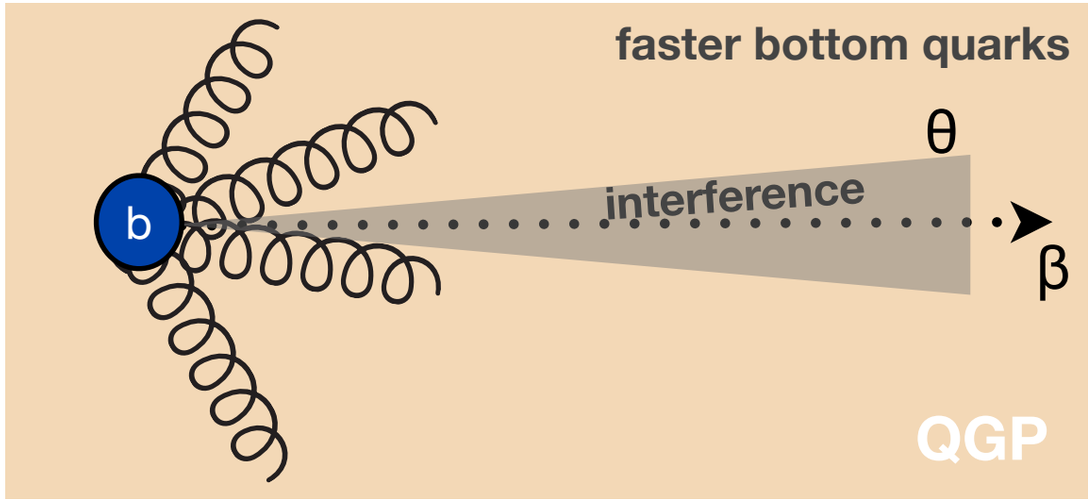
Friday, April 8, 2016 from **12:00** to **15:00** (US/Eastern)
at **Universe**

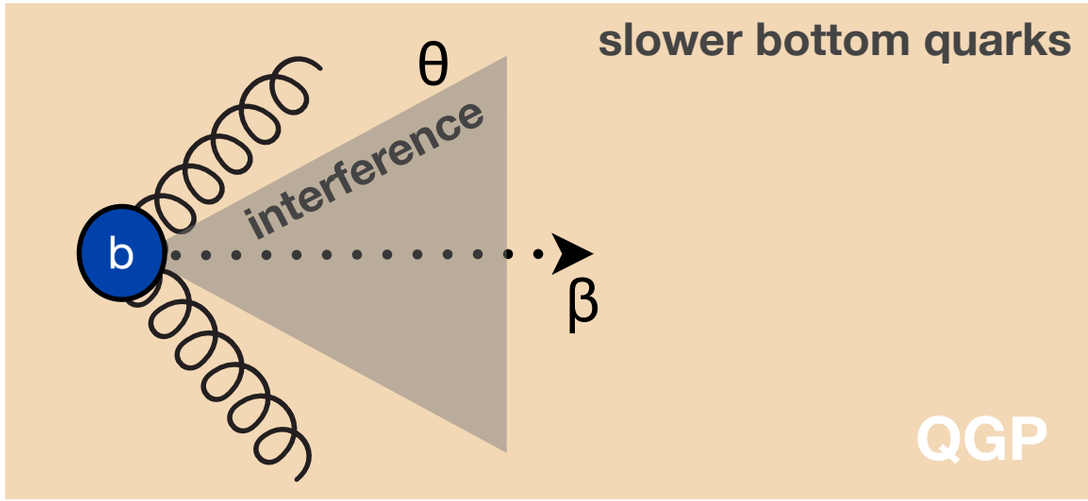
PHENIX

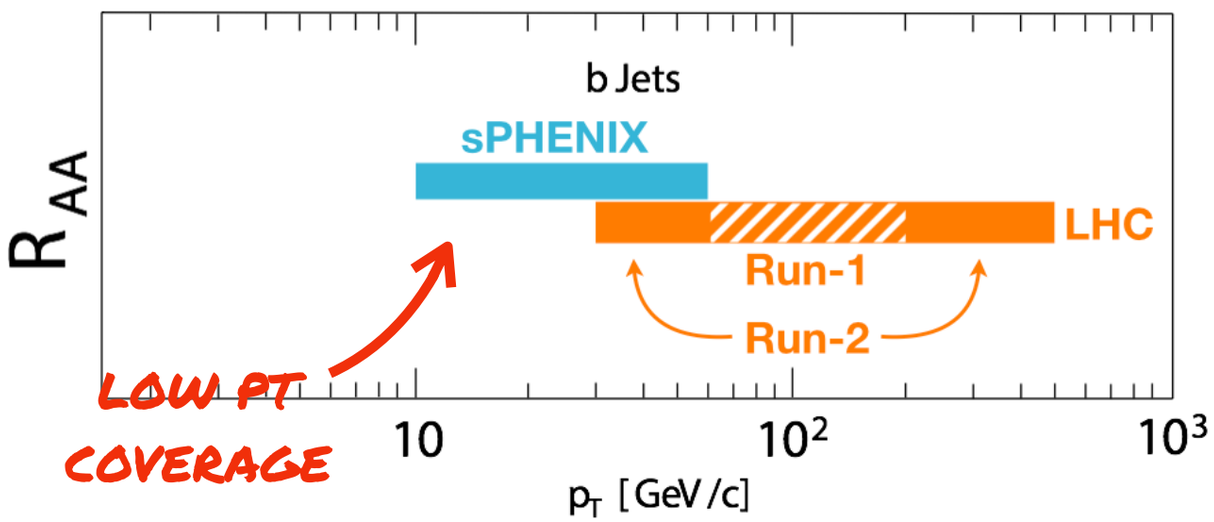
Los Alamos
NATIONAL LABORATORY
EST.1943

B-jet Physics: Energy Loss





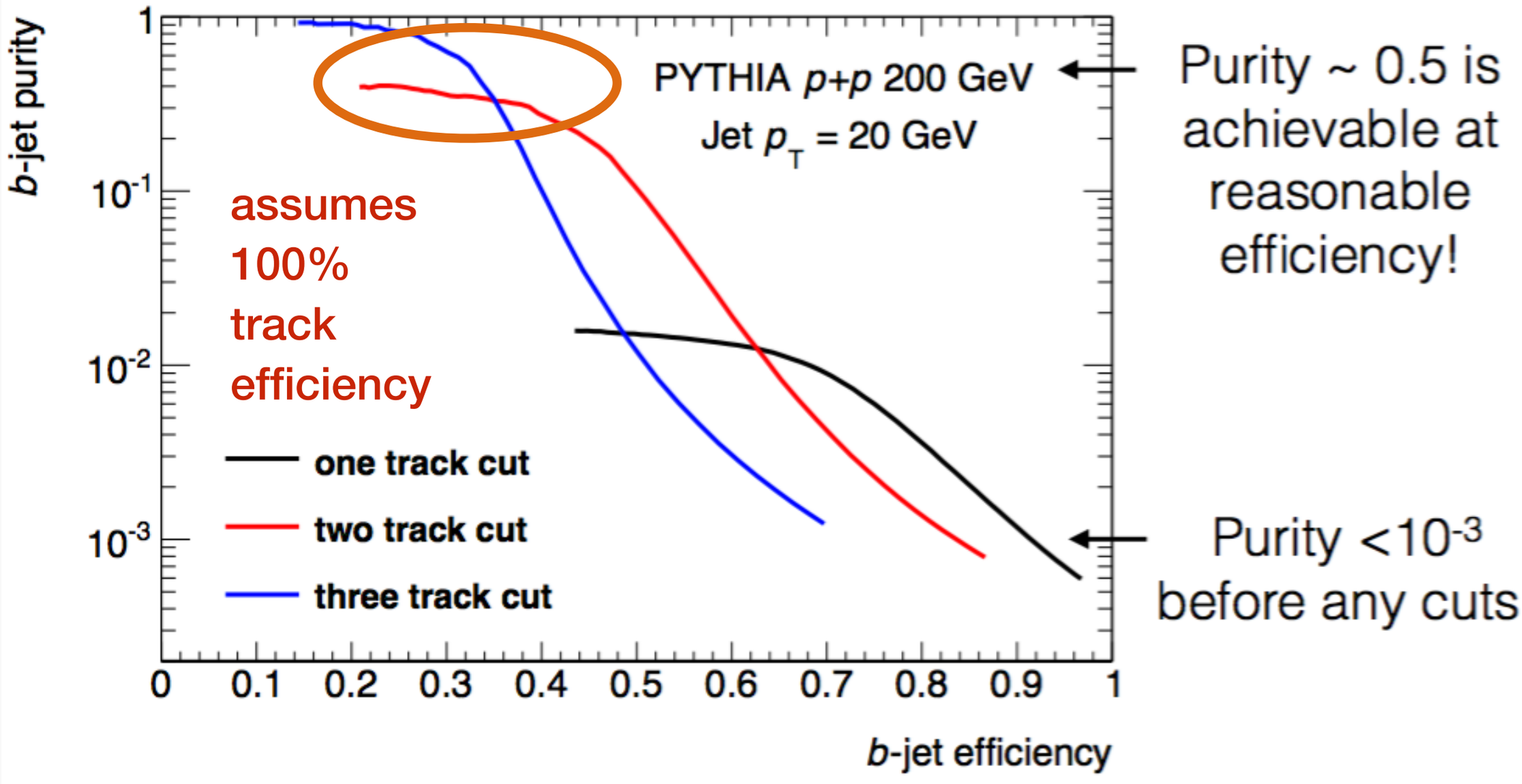




B-jet Identification Methodology

from the April Review…

b-jet performance in *p*+*p*



P vs. **E** curves for requiring **1**, **2** or **3** tracks with S_{DCA} above some minimum value

12

Trac

La
e

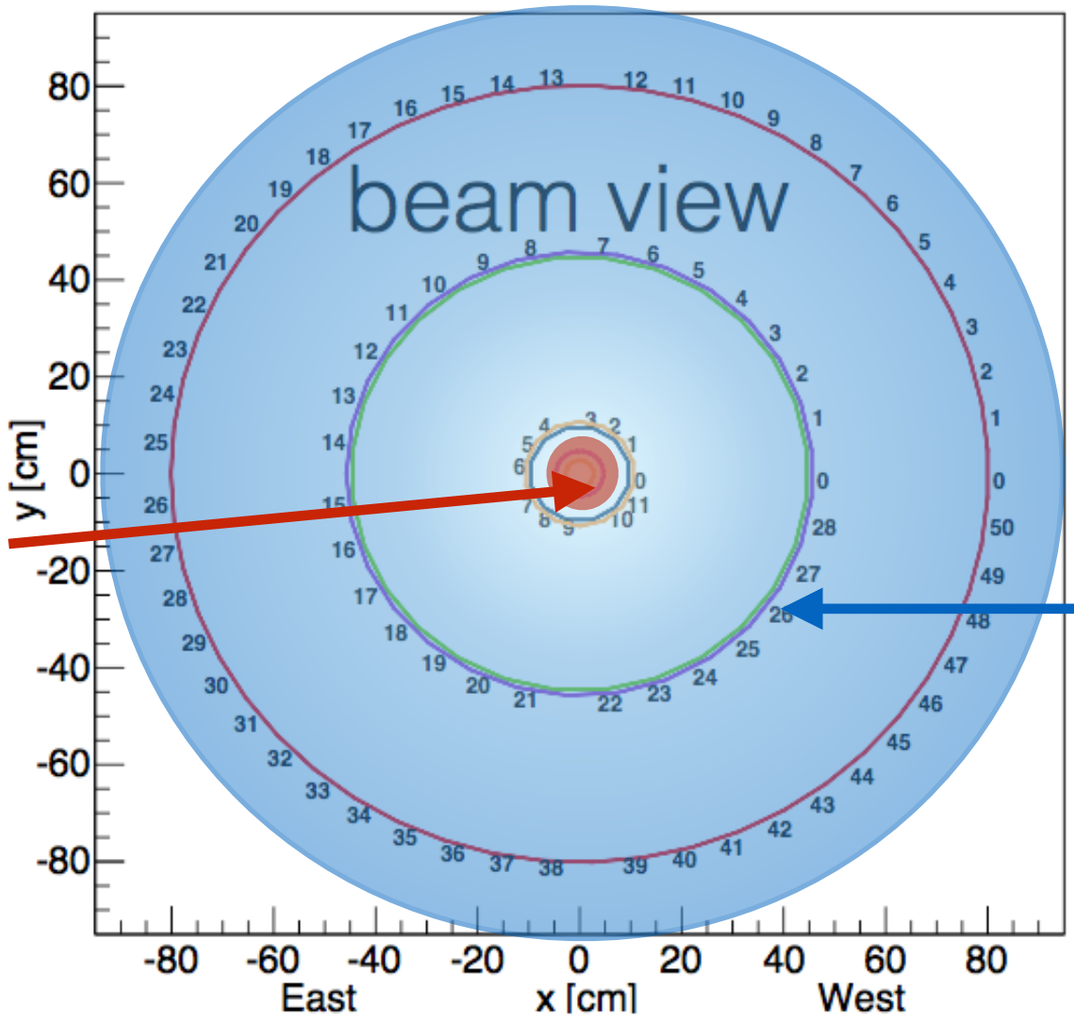
Na

14

highest *S* track

Partial Factorization: Inner Tracking Goals

Inner Tracking
(0 < r < 10-30 cm)



Outer Tracking
(10-30 < r < 80 cm)

Inner tracking:

(1) precision track position (DCA, 2nd vertexing)

(2) high resolution collision vertexing

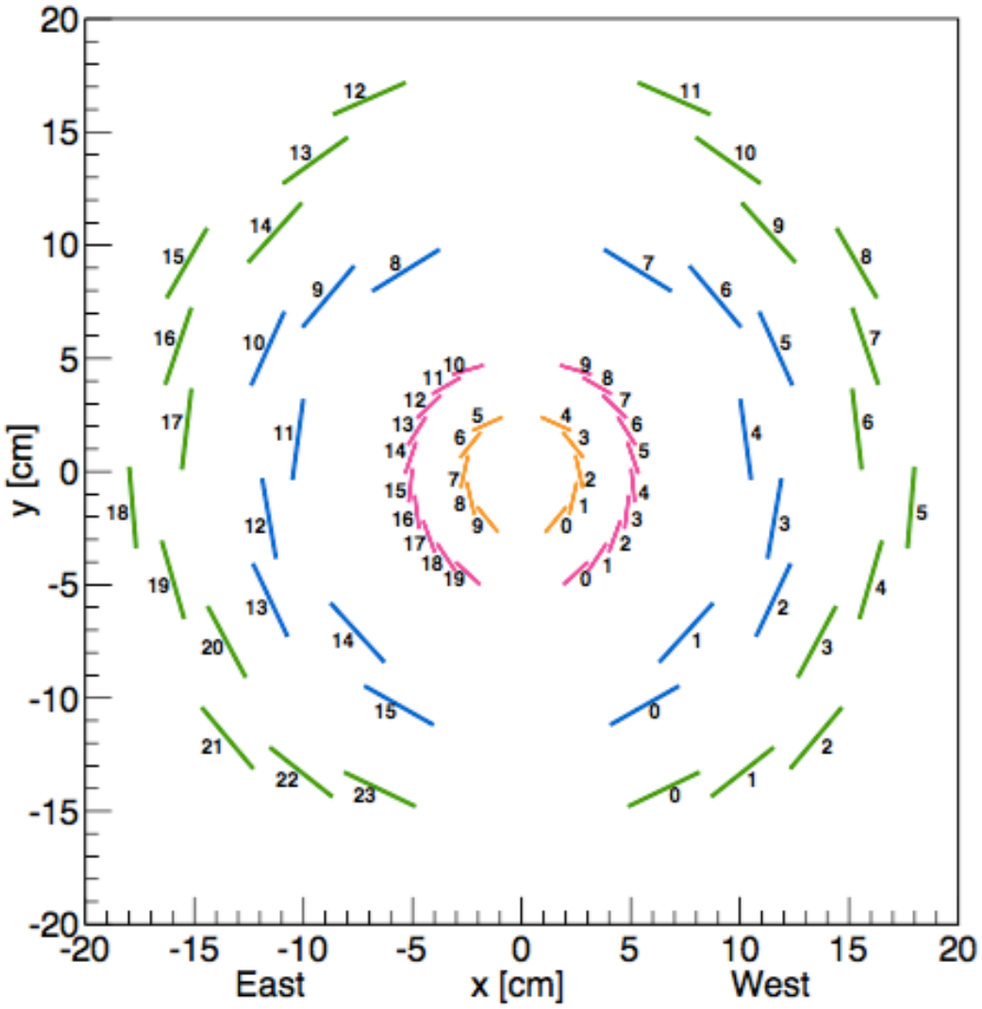
(3) pattern recognition ambiguity breaking

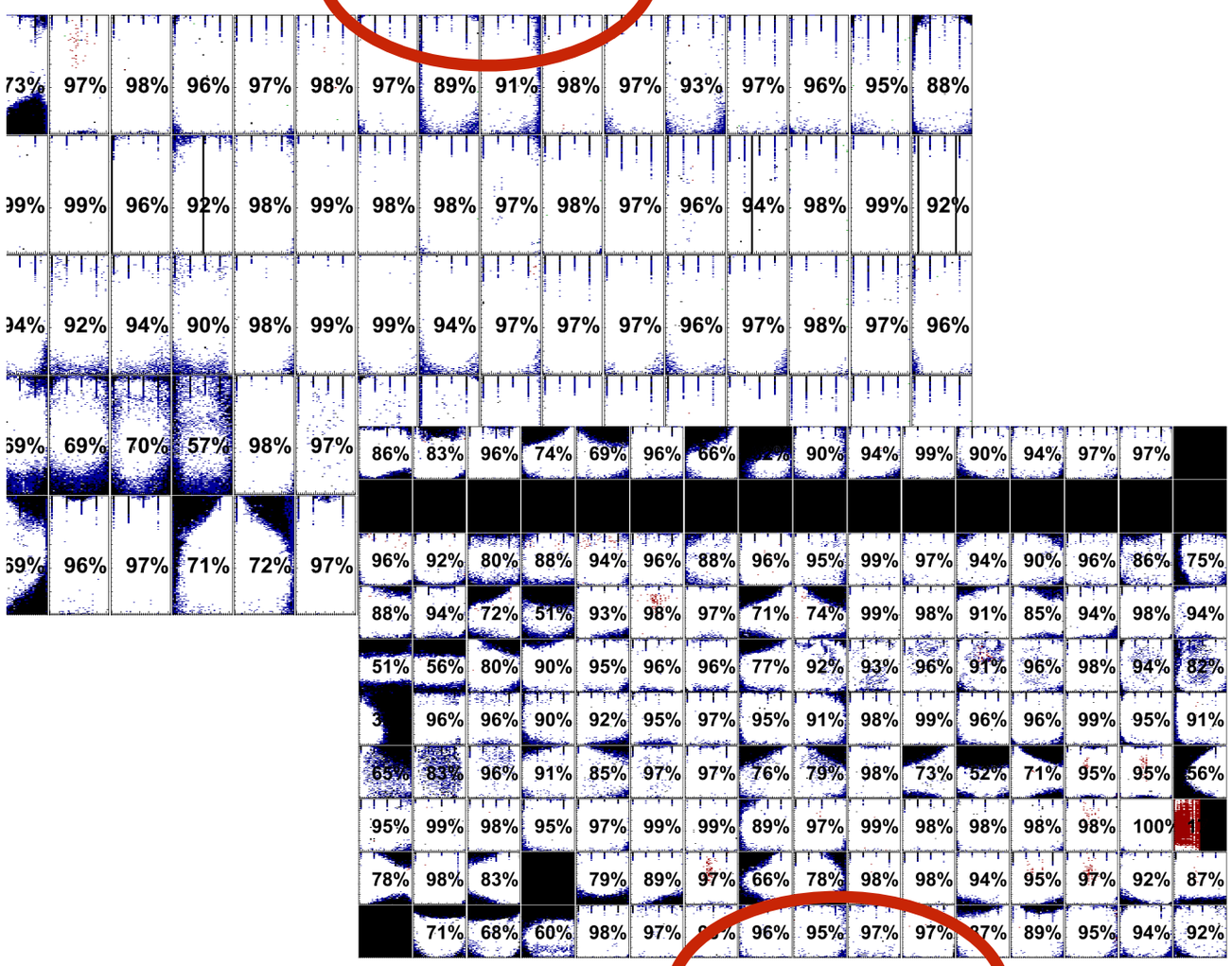
Outer tracking:

(1) momentum resolution optimization

(2) pattern recognition ambiguity breaking

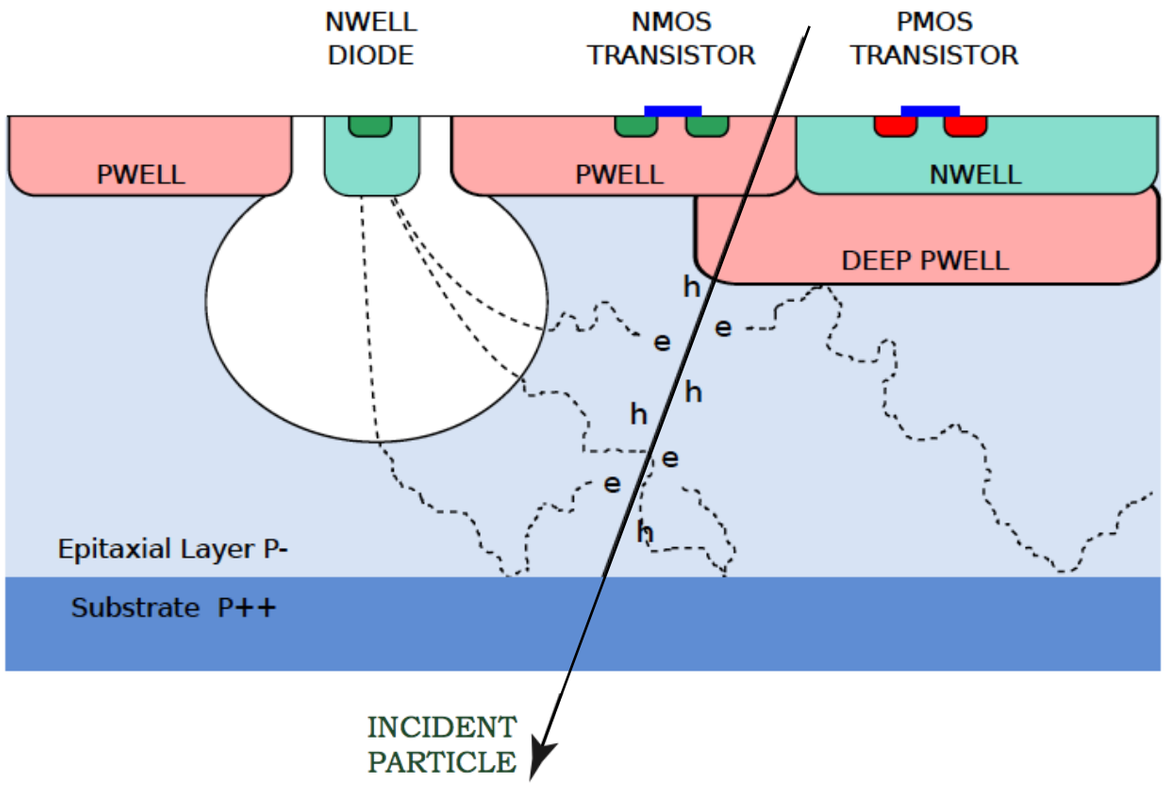
Tracking Option: Pixels

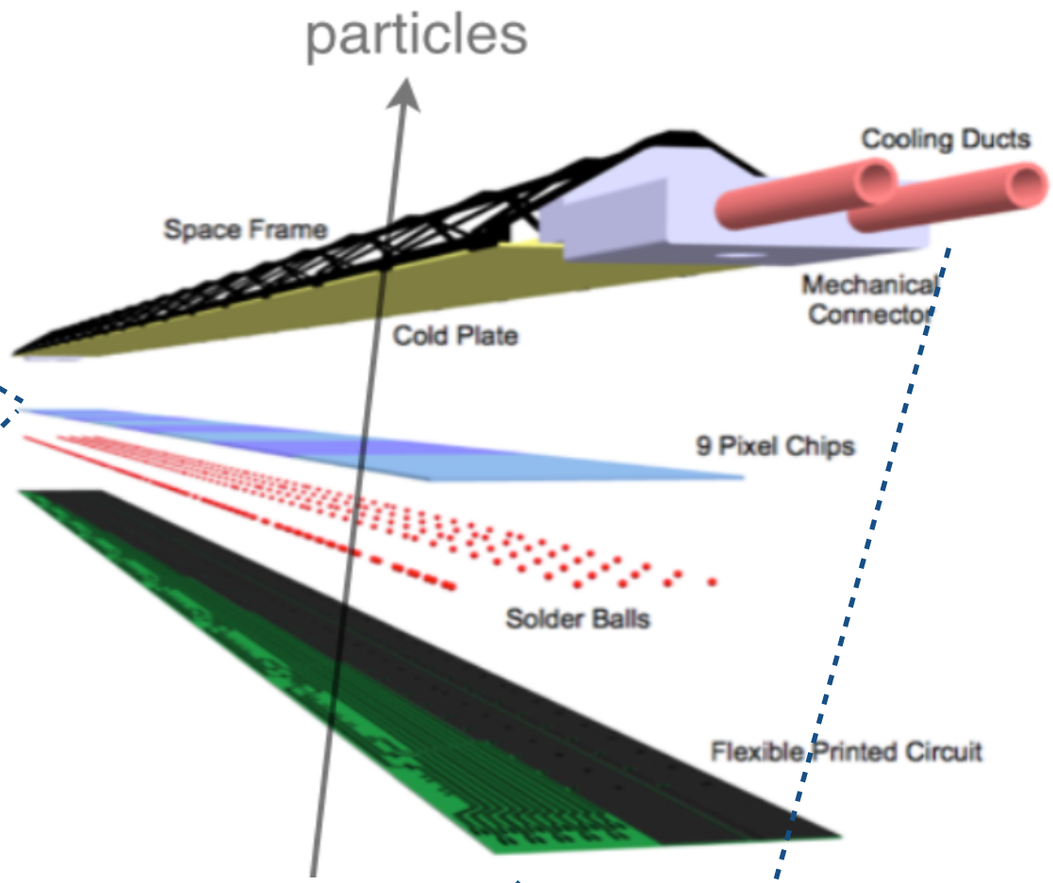


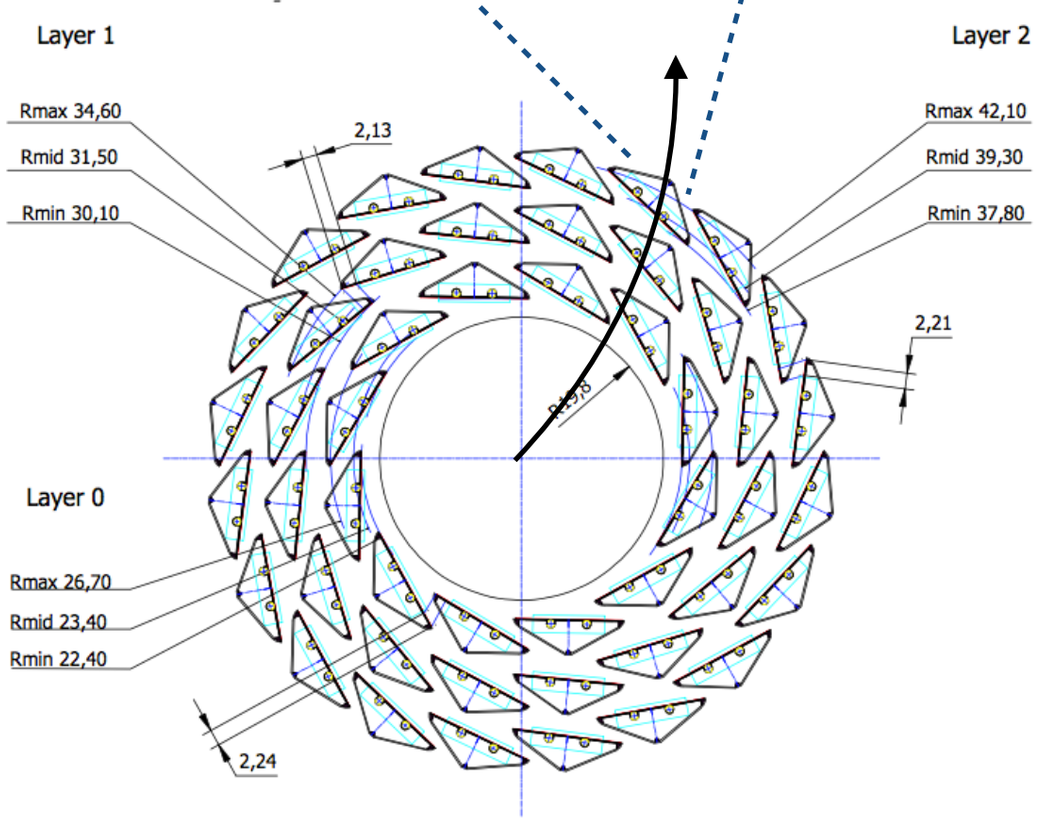


Station	Layer	radius (cm)	pitch (μm)	sensor length (cm)	depth (μm)	total thickness X_0%	area (m^2)
Pixel	1	2.4	50	0.425	200	1.3	0.034
Pixel	2	4.4	50	0.425	200	1.3	0.059
S0a	3	7.5	58	9.6	240	1.0	0.18

Tracking Option: MAPS sensors







Inner Silicon Concept:

Thin, fine pitch (<30 um), large efficiency (99.9…%)
Optimizations for material thickness, ~0.3%/layer
Integration time: ~2-4 us

Goal:

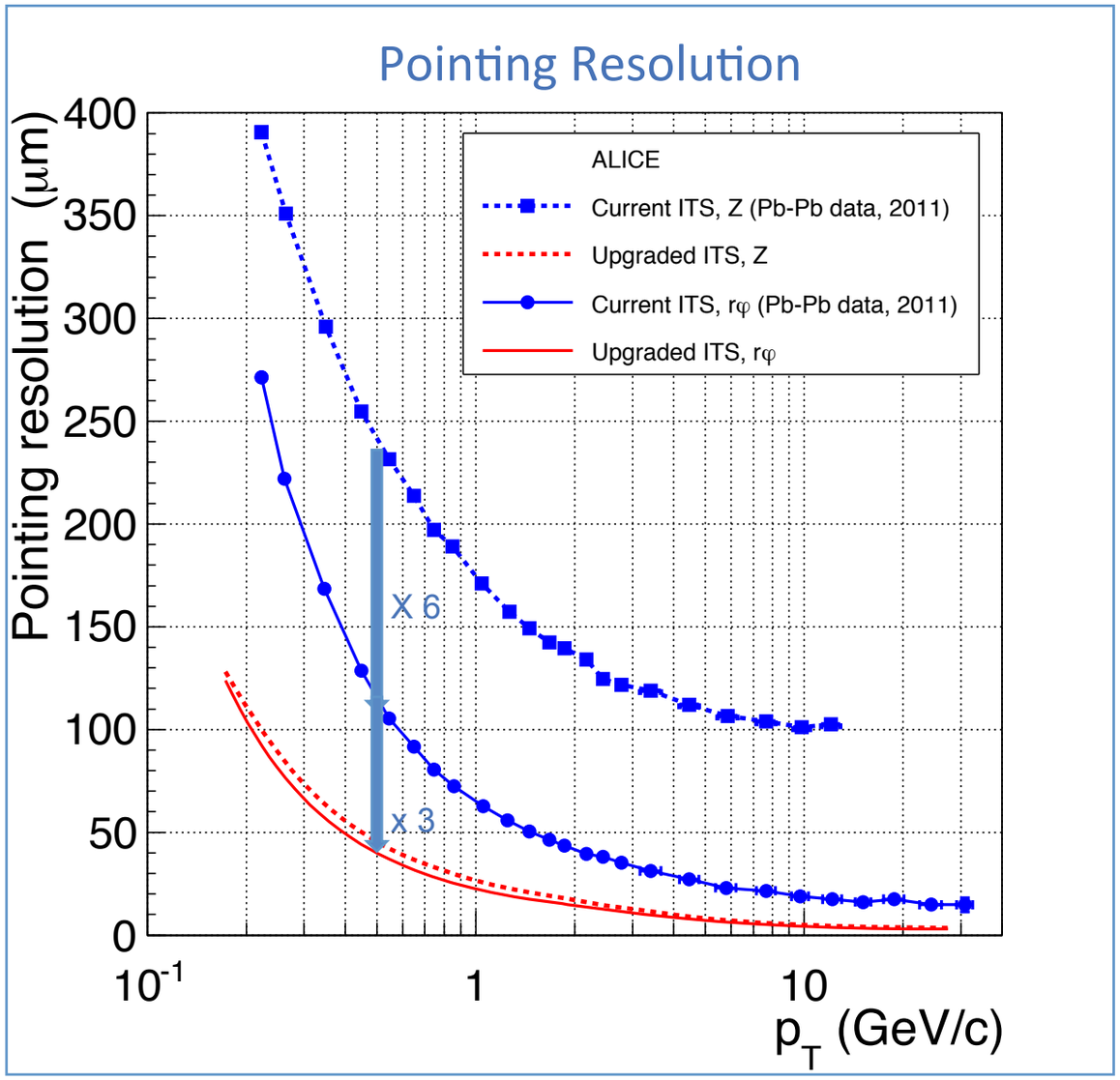
Precision tracking & vertexing for b-jet identification and other tracking duties

Opportunity:

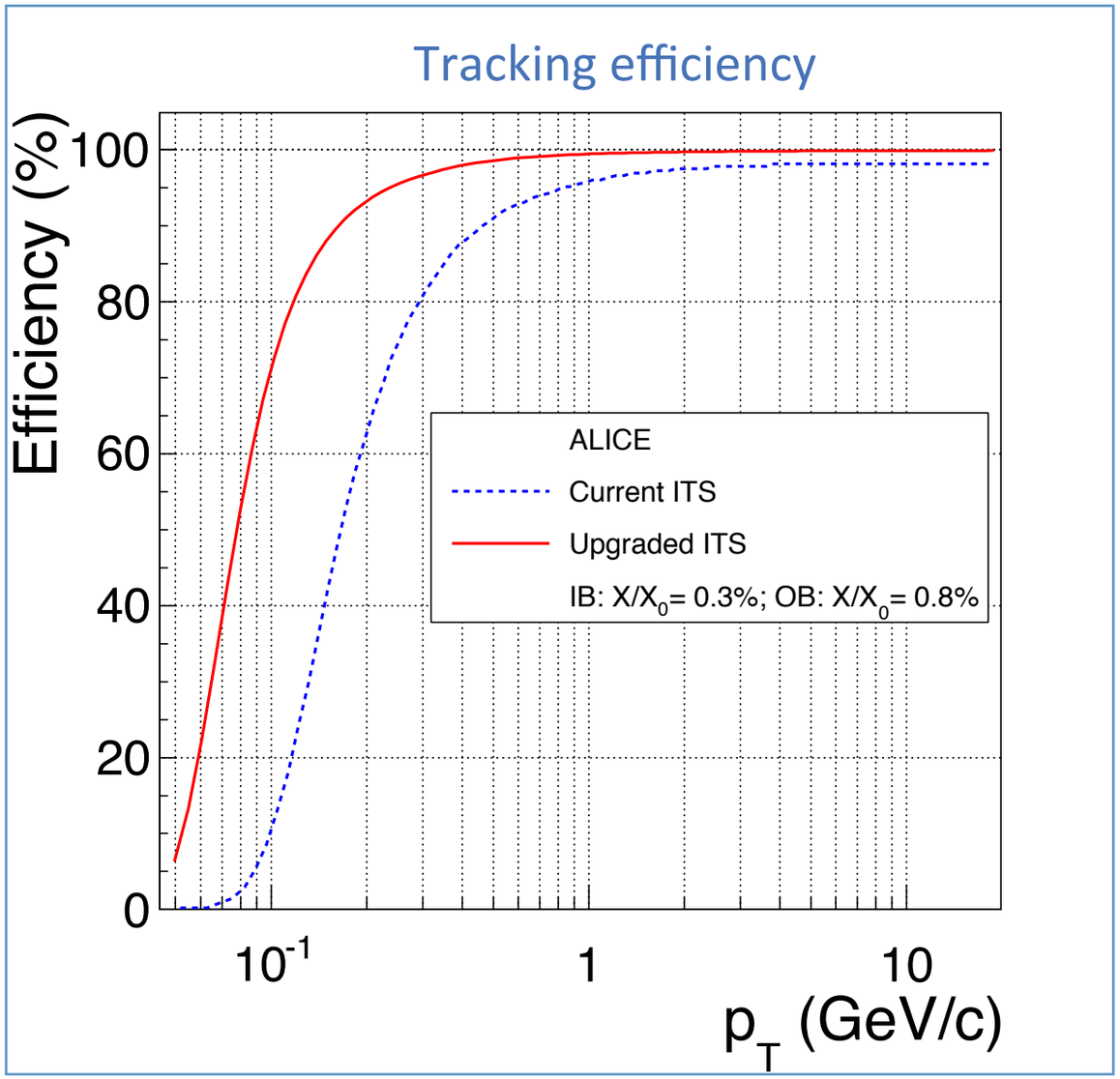
Reuse thin inner tracking layers during the EIC era

MAPS Technology Motivation

Impact parameter resolution



Tracking efficiency (ITS standalone)



~40 μm at p_T = 500 MeV/c

MAPS Cost & Schedule Workfest

https://indico.bnl.gov/conferenceDisplay.py?confId=1741

sPHENIX MAPS Cost & Schedule Workfest

from 30 March 2016 to 01 April 2016 (US/Mountain) *El Dorado Hotel*
US/Mountain timezone

Search

✉ Organizers

The purpose of this 3 day workfest is to define and document the cost and schedule for the MAPS based tracking options under consideration for the sPHENIX detector. The interactive workfest format will be organized into topical breakout teams with MAPS, engineering, and C&S experts we are gathering from ALICE, sPHENIX, and other projects and will minimize time spent in presentations.

Update 3/2/16: The workfest will be held at the El Dorado Hotel. The hotel is located just a short walk west of the historic downtown square. See http://www.eldoradohotel.com for more hotel details. We've arranged for a block of rooms is available now and can be booked at the workfest/gov't rate ($99/night) if you follow: https://gc.synxis.com/rez.aspx?Hotel=63150&Chain=17123&Dest=Santa Fe &template=GCF&shell=GCF&locale=en-US&arrive=3/29/2016&depart=4/1/2016&adult=1&child=0&group=sPHENIX which will lead you to a web form for the conference. If you decide to call the hotel directly at 505-995-4500, our call-in/group code for the reservations is: sPHENIX.

FAQ: *Should I fly out of ABQ on Friday evening or Saturday morning?*

The answer to this is if you can find a suitable flight or not. We expect that some participants will book flights out Friday evening and leave the workfest in the afternoon to take those flights. Not all participants will find a flight and so Saturday morning will be an option for them. Our plan is to be finalizing the C&S document on Friday afternoon. The organizers will stay until the end of the day and go to dinner with the remaining participants. The drive from Santa Fe to the airport (ABQ) will take approximately 1 hour.

Dates: from 30 March 2016 09:00 to 01 April 2016 17:30

Timezone: US/Mountain

MAPS Cost & Schedule Workfest

is located just a
hotel.com for more
be booked at the

ill lead you to a
995-4500, our

some participants
to take those
an option for
he organizers will
nts. The drive from

Location: *El Dorado Hotel*
309 W San Franscisco St.

Participants

Current registrants (17)

name	institution	position	city	country/region
Prof. FIELDS, Douglas	University of New Mexico	Professor	Albuquerque	UNITED STATES OF AMERICA
FRAWLEY, Anthony	Florida State University		Tallahassee	UNITED STATES OF AMERICA
GREINER, leo	LBNL		Berkeley	UNITED STATES OF AMERICA
Dr. HUANG, Jin	Brookhaven National Lab		Upton	UNITED STATES OF AMERICA
Dr. LIM, Sanghoon	LANL	post-doc	Los ALAMOS	UNITED STATES OF AMERICA
Dr. LIU, Ming	Los Alamos		Los Alamos	UNITED STATES OF AMERICA
Dr. LI, Xuan	LANL		Los Alamos	UNITED STATES OF AMERICA
Dr. MCCUMBER, Michael	Los Alamos National Laboratory		Los Alamos, NM	UNITED STATES OF AMERICA
MCGLINCHEY, Darren	University of Colorado Boulder	Postdoc	Boulder	UNITED STATES OF AMERICA
Dr. O'BRIEN, Edward	Brookhaven National Lab		Upton, NY	UNITED STATES OF AMERICA
Prof. OKOROKOV, Vitalii	National Research Nuclear University MEPhI	Professor	Moscow	RUSSIA
Dr. PEREPELITSA, Dennis	Brookhaven National Laboratory (US)	Goldhaber Fellow	New York	UNITED STATES OF AMERICA
Prof. REDWINE, Robert	MIT	Director, Bates Laboratory	Cambridge, MA	UNITED STATES OF AMERICA
Prof. ROLAND, Gunther	MIT		Cambridge	GERMANY
SICHTERMANN, Ernst	Lawrence Berkeley National Laboratory		Berkeley	UNITED STATES OF AMERICA
Mr. SONDHEIM, Walter	LANL		Los Alamos	UNITED STATES OF AMERICA
Dr. VIDEBAEK, Flemming	Brookhaven National Laboratory		Upton, NY11973	UNITED STATES OF AMERICA

Good turnout
20 people attend in-person
most listed here as registrants

Key Invited Experts:
Leo Greiner, LBL
Flemming Videbaek, BNL
Luciano Musa, CERN (phone)

Participants

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name
Prof. FIELD
FRAWLEY, A
GREINER, I
Dr. HUANG,
Dr. LIM, Sa
Dr. LIU, Mir
Dr. LI, Xuar
Dr. MCCUM
MCGLINCH
Dr. O'BRIEN
Prof. OKOR
Dr. PEREPE
Prof. REDW
Prof. ROLA
SICHTERMA
Mr. SONDH
Dr. VIDEBA

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ants
L
none)

Presentations

1st Day

09:05 **MAPS in sPHENIX** *20'*
Speaker: Prof. Tony Frawley (FSU)
Material: **Slides**

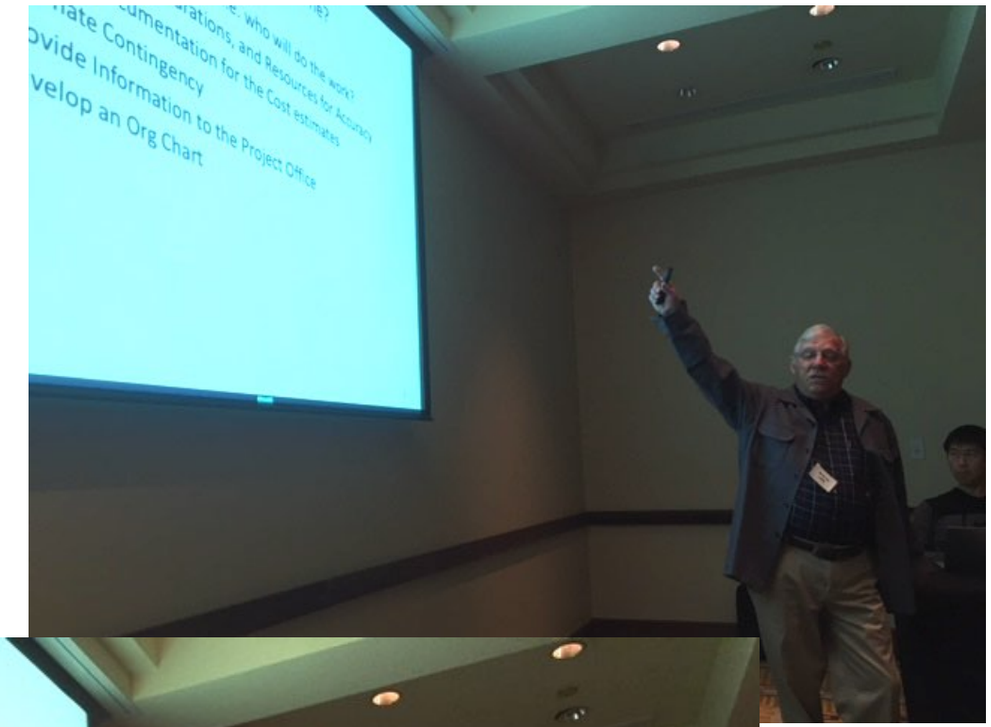
09:25 **Draft Cost & Schedule Document and Project File** *20'*
Speaker: Dr. David Lee (LANL)
Material: **Slides**

09:45 **HFT Project Management Perspective** *45'*
Speaker: Dr. Flemming Videbaek (BNL)
Material: **Slides**

10:30 **MAPS Readout Experience** *45'*
Speaker: Dr. Leo Greiner (LBL)
Material: **Slides**

2nd Day

10:00 **ALICE ITS Overview & Discussion** *2h0'*
Speaker: Dr. Luciano Musa (CERN)
Material: **Slides**



Draft Project File

pre-prepared by David Lee (FVTX, LBNE short baseline)

View | Clipboard | Font | Schedule | Tasks

	WBS	Task Name	Duration	Start	Finish	Cost	Fixed Cost	Cost Contingency(30%	2014 Q1 Q2 Q3
1	**1**	**sPIT Project**	**1084 days**	**Mon 10/3/16**	**Thu 11/26/20**	**$3,016,960.00**	**$0.00**	**$3,922,048.00**	
2	1.1	Start Construction(CD-3)	1 day	Mon 12/24/18	Mon 12/24/18	$0.00	$0.00	$0.00	
3	1.2	Start R&D LANL	1 day	Mon 10/3/16	Mon 10/3/16	$0.00	$0.00	$0.00	
4	1.3	Start R&D Other Institutions	1 day	Mon 10/3/16	Mon 10/3/16	$0.00	$0.00	$0.00	
5	**1.4**	**Project Management**	**800 days**	**Fri 12/2/16**	**Fri 12/27/19**	**$220,800.00**	**$0.00**	**$287,040.00**	
6	1.4.1	Projecy Manager	800 days	Fri 12/2/16	Fri 12/27/19	$73,600.00	$0.00	$95,680.00	
7	1.4.2	Mechanical Liason Engineer	800 days	Fri 12/2/16	Fri 12/27/19	$73,600.00	$0.00	$95,680.00	
8	1.4.3	Electronics Liason Engineer	800 days	Fri 12/2/16	Fri 12/27/19	$73,600.00	$0.00	$95,680.00	
9	**1.5**	**Pixel Chips**	**434 days**	**Mon 10/3/16**	**Thu 5/31/18**	**$58,160.00**	**$0.00**	**$75,608.00**	
10	**1.5.1**	**ALPIDE Chip**	**434 days**	**Mon 10/3/16**	**Thu 5/31/18**	**$58,160.00**	**$0.00**	**$75,608.00**	
11	1.5.1.9	Obtain legal appoval to use CERN	6 mons	Mon 10/3/16	Fri 3/17/17	$44,160.00	$0.00	$57,408.00	
12	1.5.1.2	procure prototype chip	20 wks	Mon 3/20/17	Fri 8/4/17	$0.00	$0.00	$0.00	
13	1.5.1.3	Prototype DAQ Components from	20 wks	Mon 3/20/17	Fri 8/4/17	$0.00	$0.00	$0.00	
14	1.5.1.4	test prototype chip	4 wks	Mon 8/7/17	Fri 9/1/17	$0.00	$0.00	$0.00	
15	1.5.1.5	Attach flex cable	20 wks	Wed 11/1/17	Tue 3/20/18	$10,000.00	$10,000.00	$13,000.00	
16	1.5.1.6	test short chip, cable assemblies	20 wks	Wed 11/15/17	Tue 4/3/18	$0.00	$0.00	$0.00	
17	1.5.1.7	Rad Damage Testing at WNR	2 mons	Wed 4/4/18	Tue 5/29/18	$0.00	$0.00	$0.00	
18	1.5.1.8	design review	2 days	Wed 5/30/18	Thu 5/31/18	$4,000.00	$0.00	$5,200.00	
19	**1.6**	**Prototype Assembly**	**30 days**	**Wed 10/3/18**	**Tue 11/13/18**	**$112,000.00**	**$0.00**	**$145,600.00**	
20	1.6.1	Assemble prototype	2 wks	Wed 10/3/18	Tue 10/16/18	$32,000.00	$0.00	$41,600.00	
21	1.6.2	Test prototype	4 wks	Wed 10/17/18	Tue 11/13/18	$80,000.00	$0.00	$104,000.00	
22	**1.7**	**Readout electronics**	**566 days**	**Mon 10/3/16**	**Mon 12/3/18**	**$636,800.00**	**$0.00**	**$827,840.00**	
23	**1.7.1**	**Readout Test Stand**	**50 days**	**Mon 8/7/17**	**Fri 10/13/17**	**$48,000.00**	**$0.00**	**$62,400.00**	
24	1.7.1.1	Design	4 wks	Mon 8/7/17	Fri 9/1/17	$18,400.00	$0.00	$23,920.00	
25	1.7.1.2	Procure	6 wks	Mon 9/4/17	Fri 10/13/17	$29,600.00	$20,000.00	$38,480.00	
26	**1.7.2**	**Mass Termination Board**	**322 days**	**Tue 10/4/16**	**Wed 12/27/17**	**$6,000.00**	**$0.00**	**$7,800.00**	
27	1.7.2.1	design(ALICE)	1 day	Tue 10/4/16	Tue 10/4/16	$0.00	$0.00	$0.00	
28	1.7.2.2	obtain prototype	10 wks	Wed 10/5/16	Tue 12/13/16	$0.00	$0.00	$0.00	

GANTT CHART

Work Sessions

Gold Team: Project Experts
WBS 1.4,1.9, FTE & Budget Summaries
1. Executive Overview
8. Management

Suggested Membership:

Ed O'Brien
Flemming Videbaek

Green Team: Detector Hardware Experts
WBS 1.5,1.6,1.7,1.10.1-8,1.11
4. MAPS Sensors
5. Readout Electronics

Leo Greiner

Red Team: Engineering Experts
WBS 1.8,1.12,1.10.9-12,1.12
6. Mechanics and Servicing
7. Installation

Walter Sondheim
Hubert Van Hecke

Blue Team: Science and Simulation Experts
Tracking Code Development / sPHENIX tutorials
2. Scientific Impact
3. Tracking Overview

Tony Frawley

Work Sessions

Suggested Membership:

Gold Team: Project Experts

WBS 1.4,1.9, FTE & Budget Summaries

1. Executiv
8. Manage

Ed O'Brien

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4. MAPS S
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Red Team:

WBS 1.8,1

6. Mechan
7. Installat

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Blue Team:

Tracking Code Development / sPHENIX tutorials

2. Scientific Impact
3. Tracking Overview

Tony Frawley

Work Sessions

Suggested Membership:

Gold Team: Project Experts

WBS 1.4,1.9, FTE & Budget Summaries

1. Executive Summary — *Ed O'Brien*
8. Manag — *Videbaek*

Green Tea

WBS 1.5,

4. MAPS — *einer*
5. Readou

Red Team

WBS 1.8,

6. Mecha — *ndheim*
7. Installa — *n Hecke*

Blue Team

Tracking Code Development / sPHENIX tutorials — *Tony Frawley*

2. Scientific Impact
3. Tracking Overview

Work Sessions

Suggested Membership:

Gold Team: Project Experts

WBS 1.4,1.9, FTE & Budget Summaries — *Ed O'Brien*

1. Execut — *Videbaek*
8. Manag

Green Tea

WBS 1.5, — *einer*

4. MAPS
5. Reado

Red Team

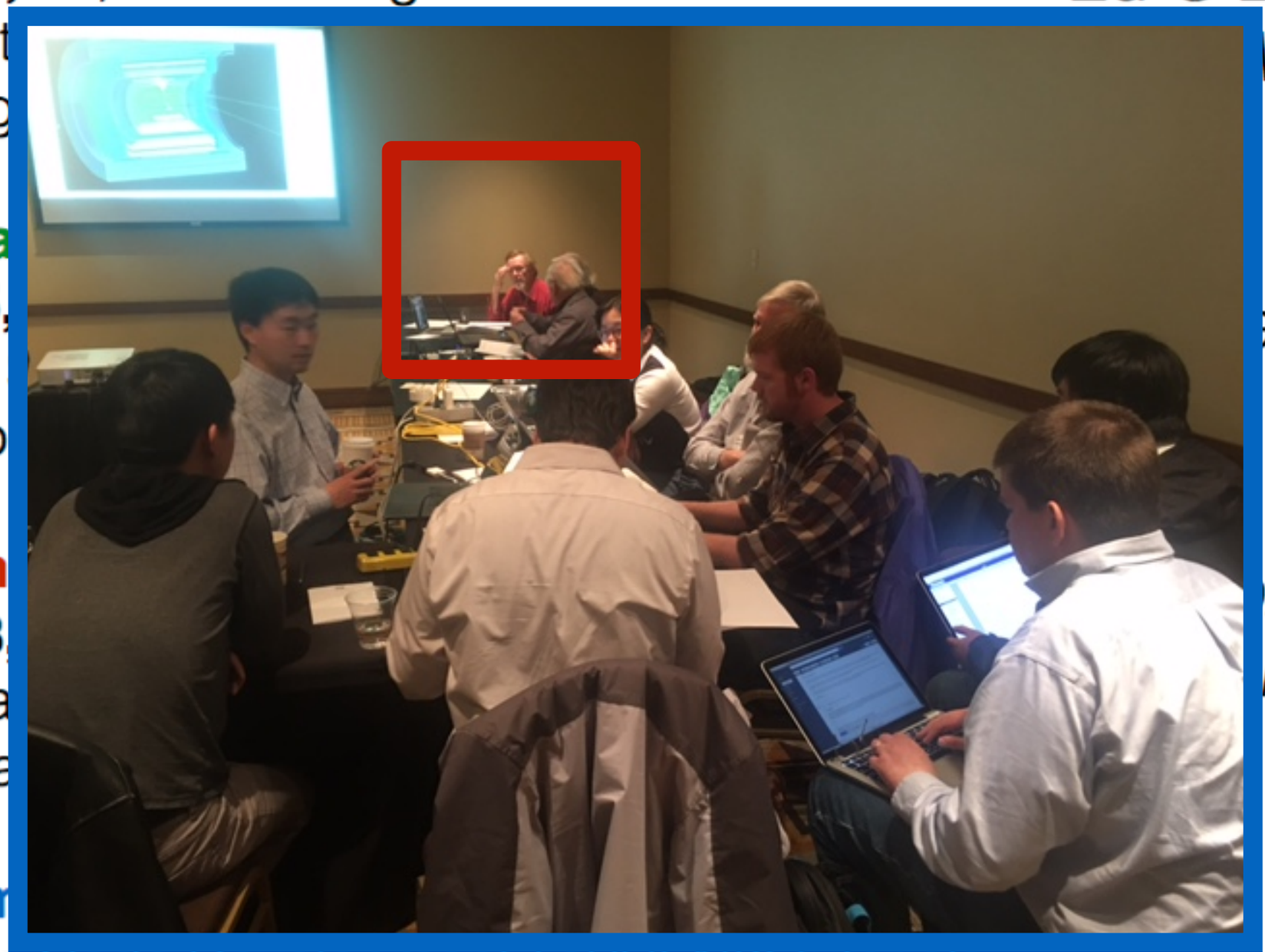
WBS 1.8 — *ndheim*, *n Hecke*

6. Mecha
7. Installa

Blue Team

Tracking Code Development / sPHENIX tutorials — *Tony Frawley*

2. Scientific Impact
3. Tracking Overview



Work Sessions

Suggested Membership:

Ed O'Brien

emming Videbaek

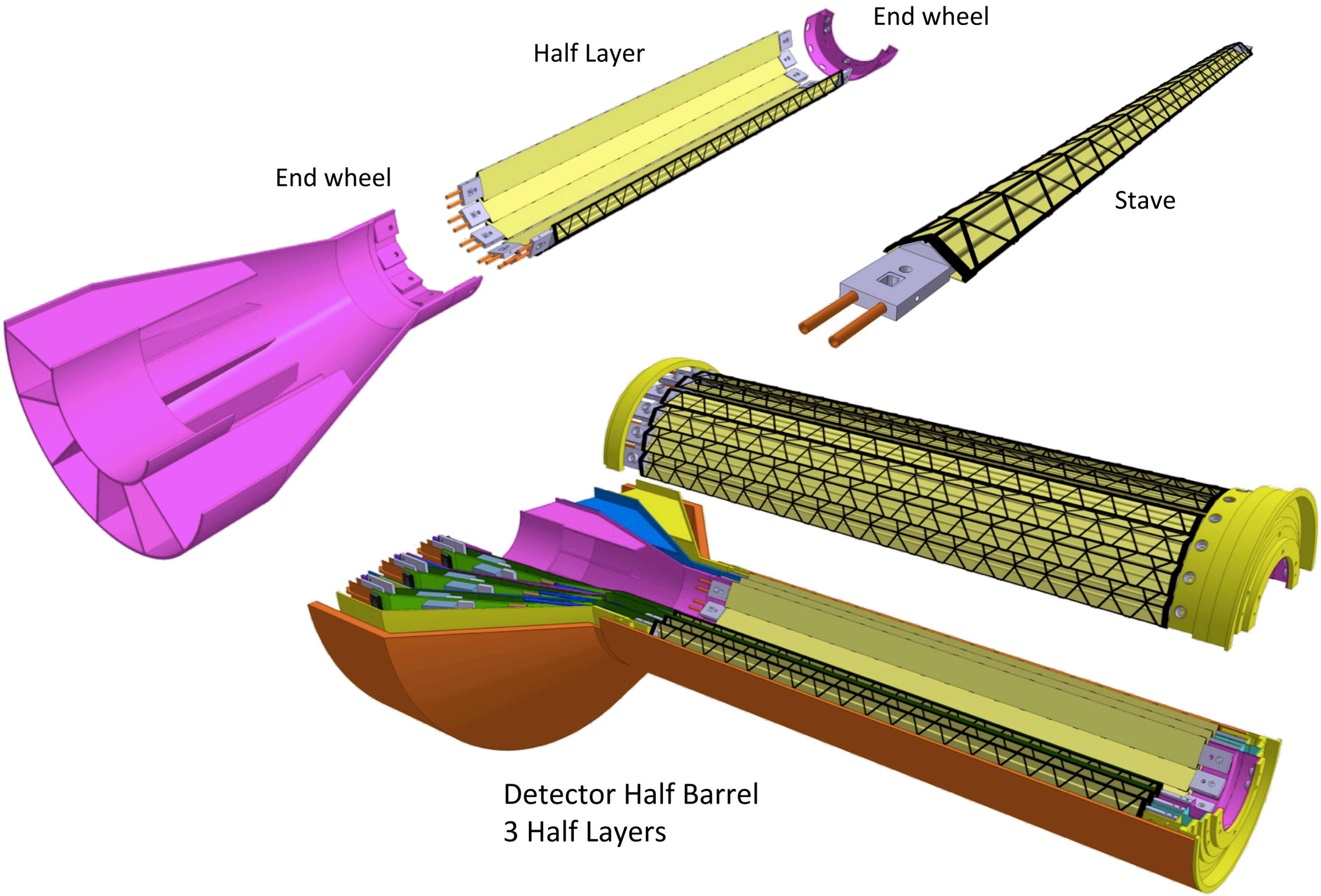
Leo Greiner

Blue Team: Science and Simulation Exp

Tracking Code Development / sPHEN

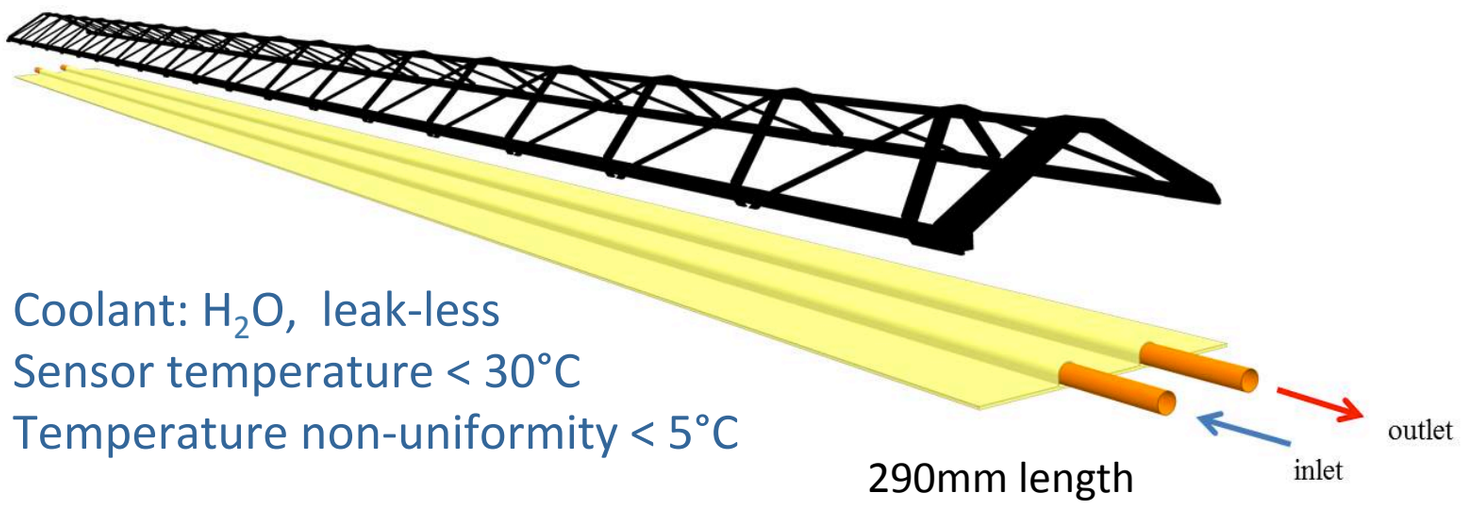
2. Scientific Impact
3. Tracking Overview

ALICE Inner Barrel Support & Services



Detector Half Barrel
3 Half Layers

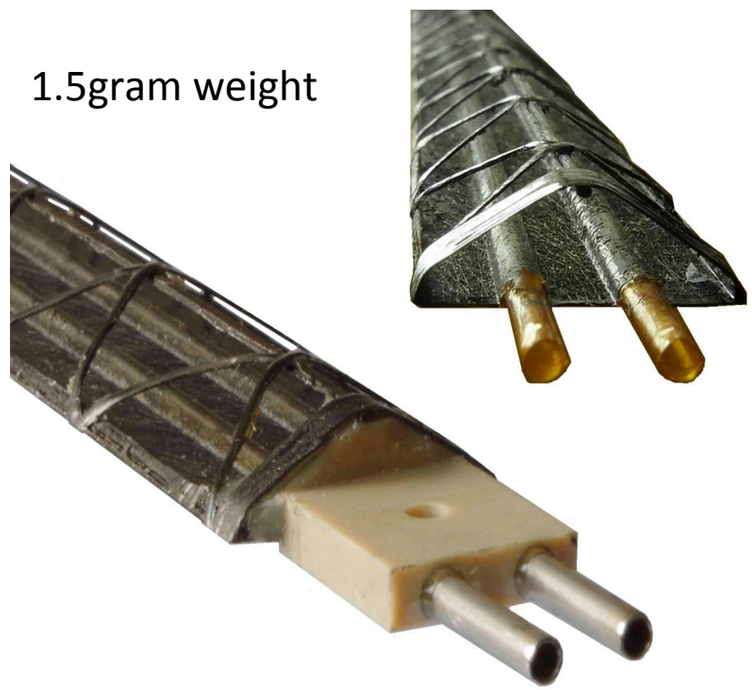
Inner Barrel Staves



Coolant: H_2O, leak-less
Sensor temperature < 30°C
Temperature non-uniformity < 5°C

290mm length

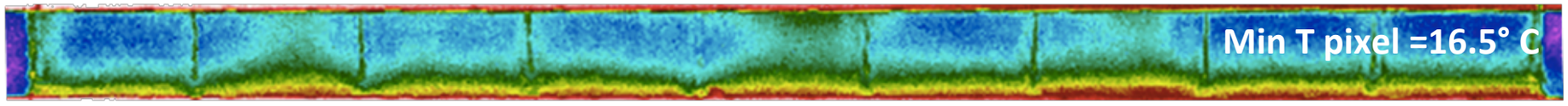
1.5gram weight



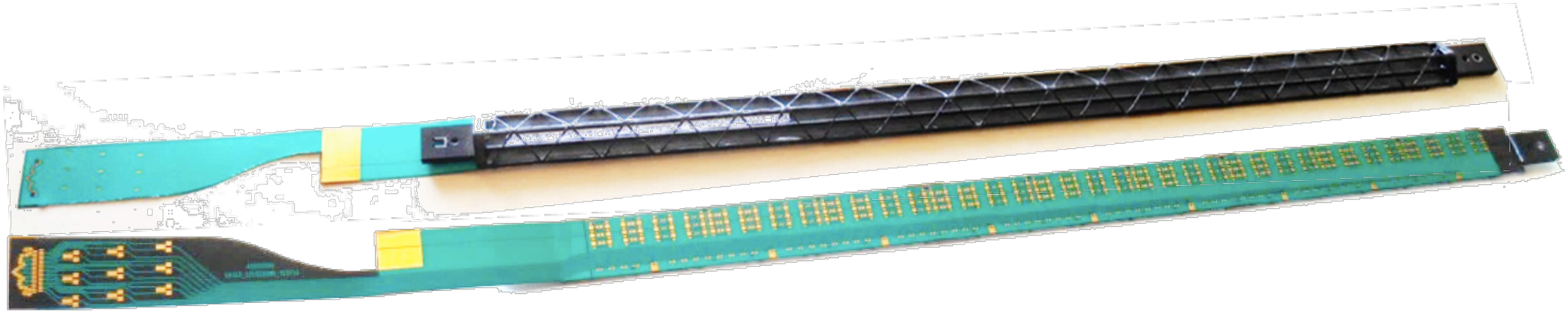
W = 100 mW / cm^2 (> x2 nominal), H_2O flow rate = 3 Lh^{-1}

Tin=15.8° C

Tout=16.6 °C



Max T periph=18.5° C



ALICE Wire Bonding

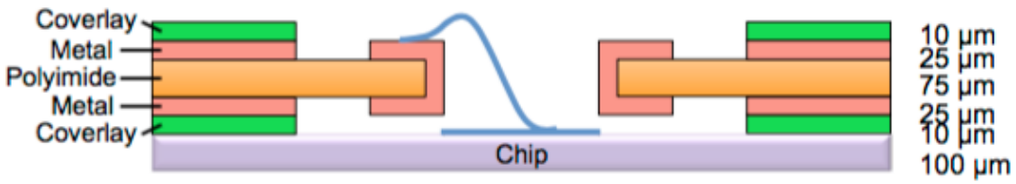
digital pathways will be wire bonded…

Interconnection of pixel chip to flex PCB

A Large Ion Collider Experiment

ALICE

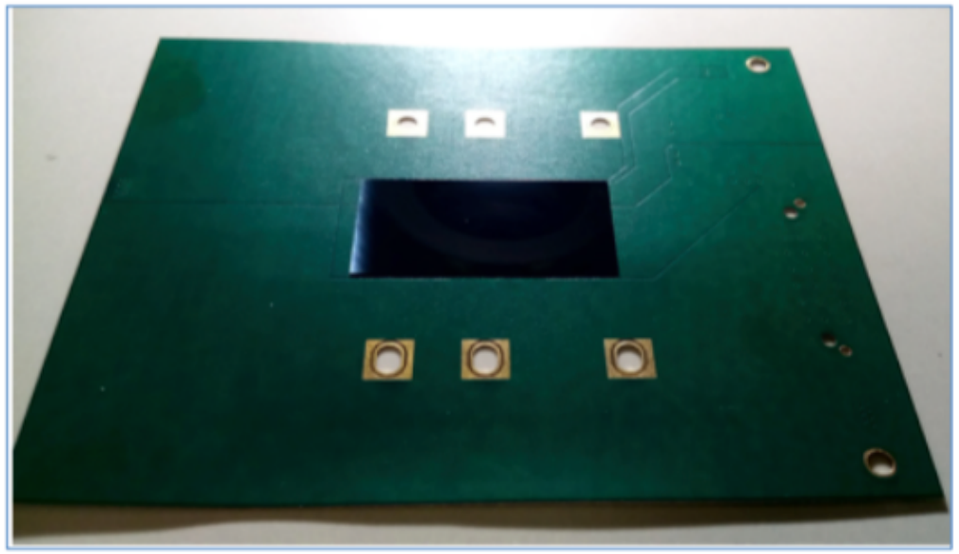
Wire bonding



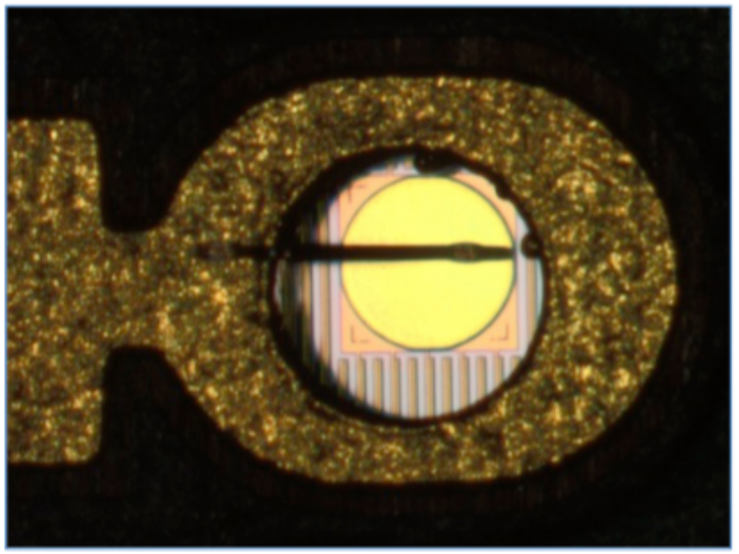
Tests with pALPIDE-3 single-chip HIC

- 5 with 25µm Al wire and standard wedge tool
- 1 with 25µm Al wire and deep access wedge tool
- **Results: all working according to specs**

First tests done in January with single-chip assemblies



Chip glued on the FPC

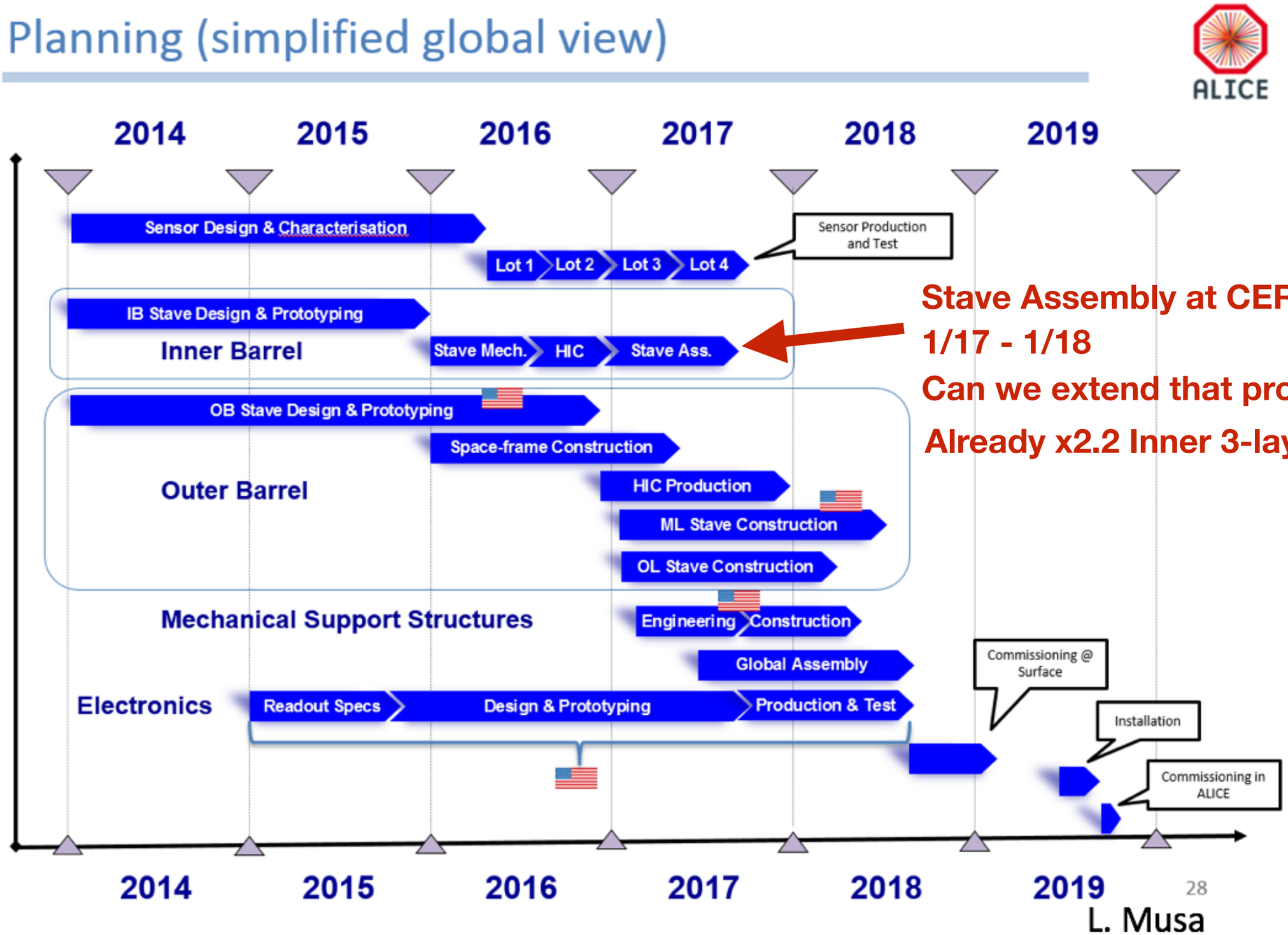


Wire Bonding

30

ALICE Construction Schedule

Current Schedule *+ add ~6 months*



Stave Assembly at CERN
1/17 - 1/18
Can we extend that production?
Already x2.2 Inner 3-layers

Two Options

“buy staves”

early funding (mid-2017) allows us to extend the CERN production of inner staves

embed people in the stave production and readout development

sPHENIX develops readout for integration into DAQ

sPHENIX develops mechanics to place barrel in experiment

Advantage: early access to full detector, cheaper with less labor, full leverage CERN expertise

Risk: early funding path

“build staves”

later funding allows us to assemble new staves

embed people in the stave production and readout development

sPHENIX procures the stave components and uses the CERN assembly lab

sPHENIX develops readout and mechanics for detector integration

Advantage: greater familiarity with the detector components, more capability for future projects

Risk: more FTEs, later detector arrival, greater cost

“Buy Staves”

GANTT CHART

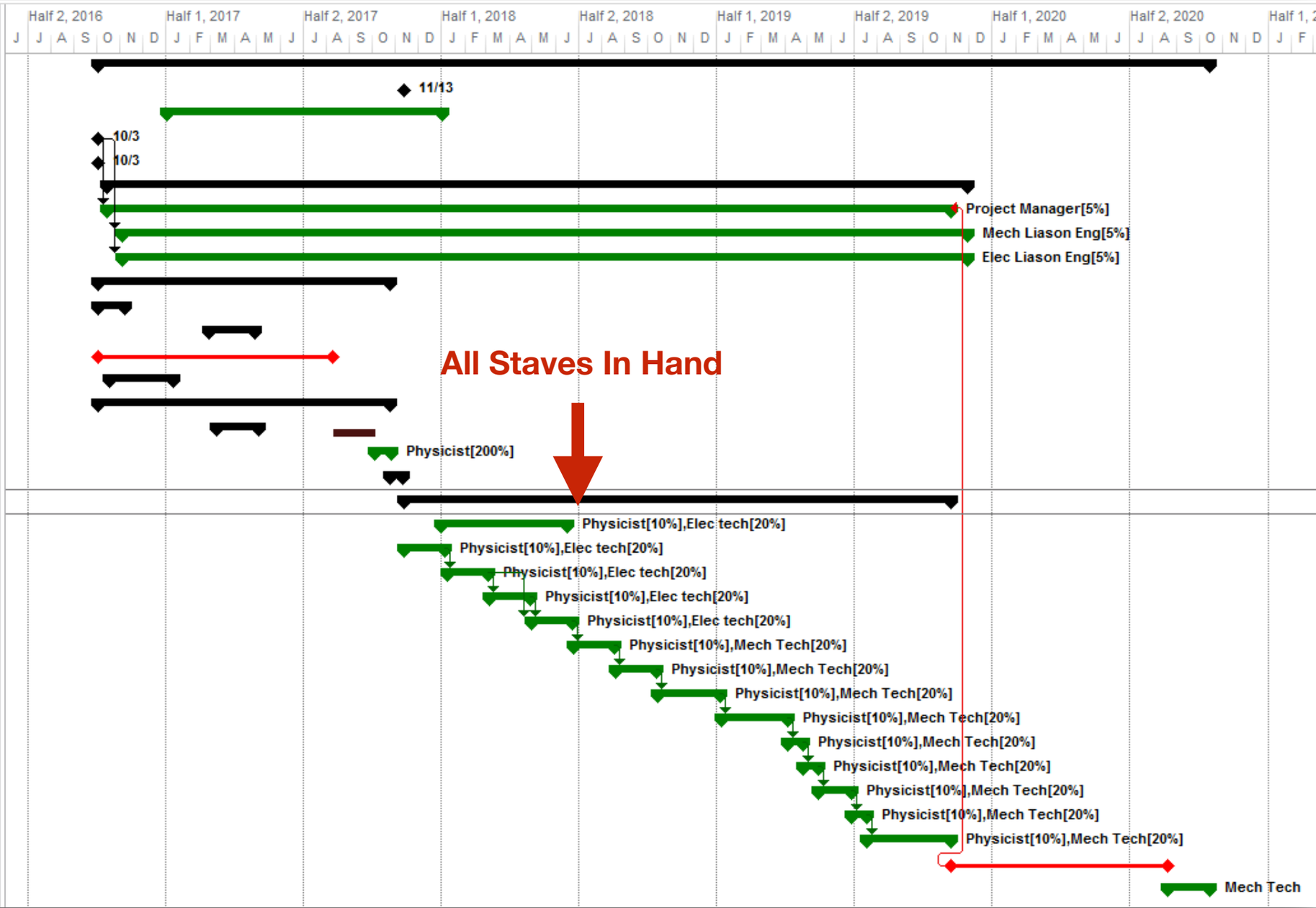
	WBS	Task Name	Duration	Start	Finish	Cost	Fixed Cost	Cost +Contingency(30%)	Predeces
1	**1**	**sPIT Project**	**1054 days**	**Mon 10/3/16**	**Thu 10/15/20**	**$3,061,898.18**	**$0.00**	**$3,980,467.64**	
2	1.1	Start Construction (CD-3)	1 day	Mon 11/13/17	Mon 11/13/17	$0.00	$0.00	$0.00	73
3	1.2	ALICE Inner Barrel Construction	261 days	Mon 1/2/17	Mon 1/1/18	$0.00	$0.00	$0.00	
4	1.3	Start R&D LANL	1 day	Mon 10/3/16	Mon 10/3/16	$0.00	$0.00	$0.00	
5	1.4	Start R&D Other Institutions	1 day	Mon 10/3/16	Mon 10/3/16	$0.00	$0.00	$0.00	
6	**1.5**	**Project Management**	**815 days**	**Fri 10/14/16**	**Fri 11/29/19**	**$147,200.00**	**$0.00**	**$191,360.00**	
7	1.5.1	Project Manager	800 days	Fri 10/14/16	Fri 11/8/19	$0.00	$0.00	$0.00	4,89SF
8	1.5.2	Mechanical Liason Engineer	800 days	Fri 11/4/16	Fri 11/29/19	$73,600.00	$0.00	$95,680.00	4,93SF
9	1.5.3	Electronics Liason Engineer	800 days	Fri 11/4/16	Fri 11/29/19	$73,600.00	$0.00	$95,680.00	4,93SF
10	**1.6**	**Design & Prototyping**	**276 days**	**Mon 10/3/16**	**Mon 10/23/17**	**$669,818.18**	**$0.00**	**$870,763.64**	
11	**1.6.1**	**Readout Test Stand**	**26 days**	**Mon 10/3/16**	**Mon 11/7/16**	**$34,800.00**	**$0.00**	**$45,240.00**	
12	1.6.1.1	Design	1 day	Mon 10/3/16	Mon 10/3/16	$0.00	$0.00	$0.00	
13	1.6.1.2	Procure 2 Stands	4 wks	Tue 10/4/16	Mon 10/31/16	$33,200.00	$30,000.00	$43,160.00	12
14	1.6.1.3	Setup	1 wk	Tue 11/1/16	Mon 11/7/16	$1,600.00	$0.00	$2,080.00	13
15	**1.6.2**	**Staves**	**45 days**	**Mon 2/27/17**	**Fri 4/28/17**	**$61,400.00**	**$0.00**	**$79,820.00**	
16	1.6.2.1	Procure 4 Staves	2 mons	Mon 2/27/17	Fri 4/21/17	$61,400.00	$55,000.00	$79,820.00	3SS+2 mons
17	1.6.2.2	Test Staves	1 wk	Mon 4/24/17	Fri 4/28/17	$0.00	$0.00	$0.00	16
18	**1.6.3**	**Readout Electronics**	**223 days**	**Mon 10/3/16**	**Wed 8/9/17**	**$130,018.18**	**$0.00**	**$169,023.64**	
19	**1.6.3.1**	**SamTec Cables**	**42 days**	**Tue 11/15/16**	**Wed 1/11/17**	**$7,818.18**	**$0.00**	**$10,163.64**	
20	1.6.3.1.1	Procure 7 SamTec Cables	2 mons	Tue 11/15/16	Mon 1/9/17	$7,818.18	$2,000.00	$10,163.64	37SS+2 wks
21	1.6.3.1.2	Test Cables	2 days	Tue 1/10/17	Wed 1/11/17	$0.00	$0.00	$0.00	20,13
22	**1.6.3.2**	**Readout Units (RDOs)**	**62 days**	**Tue 11/29/16**	**Wed 2/22/17**	**$11,400.00**	**$0.00**	**$14,820.00**	
23	1.6.3.2.1	Procure 4 RDOs	3 mons	Tue 11/29/16	Mon 2/20/17	$11,400.00	$5,000.00	$14,820.00	19SS+2 wks
24	1.6.3.2.2	Test RDOs	2 days	Tue 2/21/17	Wed 2/22/17	$0.00	$0.00	$0.00	23,13
25	**1.6.3.3**	**Optical Cables**	**42 days**	**Tue 12/13/16**	**Wed 2/8/17**	**$7,400.00**	**$0.00**	**$9,620.00**	
26	1.6.3.3.1	Procure 4 Optical Cables	2 mons	Tue 12/13/16	Mon 2/6/17	$7,400.00	$1,000.00	$9,620.00	23SS+2 wks
27	1.6.3.3.2	Test Optical Cables	2 days	Tue 2/7/17	Wed 2/8/17	$0.00	$0.00	$0.00	26,13
28	**1.6.3.4**	**Common Readout Units (CRUs)**	**2 mons**	**Mon 10/3/16**	**Fri 11/25/16**	**$16,400.00**	**$0.00**	**$21,320.00**	
29	1.6.3.4.1	Procure 2 CRUs	2 mons	Tue 12/27/16	Mon 2/20/17	$16,400.00	$10,000.00	$21,320.00	26SS+2 wks
30	1.6.3.4.2	Test CRUs	2 days	Tue 2/21/17	Wed 2/22/17	$0.00	$0.00	$0.00	29
31	**1.6.3.5**	**sPHENIX Integration**	**120 days**	**Thu 2/23/17**	**Wed 8/9/17**	**$87,000.00**	**$0.00**	**$113,100.00**	
32	1.6.3.5.1	Slow Control Design	2 mons	Thu 2/23/17	Wed 4/19/17	$29,000.00	$5,000.00	$37,700.00	30
33	1.6.3.5.2	Trigger Interface Design	2 mons	Thu 4/20/17	Wed 6/14/17	$29,000.00	$5,000.00	$37,700.00	32
34	1.6.3.5.3	DAQ Interface Design	2 mons	Thu 6/15/17	Wed 8/9/17	$29,000.00	$5,000.00	$37,700.00	33
35	**1.6.4**	**Ancillary**	**60 days**	**Tue 10/18/16**	**Mon 1/9/17**	**$56,200.00**	**$0.00**	**$73,060.00**	
36	1.6.4.1	Procure LV,HV,etc	2 mons	Tue 10/18/16	Mon 12/12/16	$31,400.00	$25,000.00	$40,820.00	13SS+2 wks
37	1.6.4.2	Procure Racks	2 mons	Tue 11/1/16	Mon 12/26/16	$11,400.00	$5,000.00	$14,820.00	36SS+2 wks
38	1.6.4.3	Procure Chiller	2 mons	Tue 11/15/16	Mon 1/9/17	$13,400.00	$7,000.00	$17,420.00	37SS+2 wks
39	**1.6.5**	**Mechanics**	**276 days**	**Mon 10/3/16**	**Mon 10/23/17**	**$387,400.00**	**$0.00**	**$503,620.00**	
40	1.6.5.1	obtain ALICE CAD model and incorporate into sPHENIX	14 days	Fri 10/21/16	Wed 11/9/16	$8,400.00	$0.00	$10,920.00	
41	**1.6.5.2**	Specifications	**15 days**	**Thu 11/10/16**	**Wed 11/30/16**	**$20,000.00**	**$0.00**	**$26,000.00**	
42	1.6.5.2.1	review heat load	1 wk	Thu 11/10/16	Wed 11/16/16	$10,000.00	$0.00	$13,000.00	40

“Buy Staves” #2

1	**1**	**sPIT Project**	**1054 days**	**Mon 10/3/16**	**Thu 10/15/20**	**$3,061,898.18**	
2	1.1	Start Construction (CD-3)	1 day	Mon 11/13/17	Mon 11/13/17	$0.00	
3	1.2	ALICE Inner Barrel Construction	261 days	Mon 1/2/17	Mon 1/1/18	$0.00	
4	1.3	Start R&D LANL	1 day	Mon 10/3/16	Mon 10/3/16	$0.00	
5	1.4	Start R&D Other Institutions	1 day	Mon 10/3/16	Mon 10/3/16	$0.00	
6	**1.5**	**Project Management**	**815 days**	**Fri 10/14/16**	**Fri 11/29/19**	**$147,200.00**	
7	1.5.1	Project Manager	800 days	Fri 10/14/16	Fri 11/8/19	$0.00	
8	1.5.2	Mechanical Liason Engineer	800 days	Fri 11/4/16	Fri 11/29/19	$73,600.00	
9	1.5.3	Electronics Liason Engineer	800 days	Fri 11/4/16	Fri 11/29/19	$73,600.00	
10	**1.6**	**Design & Prototyping**	**276 days**	**Mon 10/3/16**	**Mon 10/23/17**	**$669,818.18**	
11	**1.6.1**	**Readout Test Stand**	**26 days**	**Mon 10/3/16**	**Mon 11/7/16**	**$34,800.00**	
15	**1.6.2**	**Staves**	**45 days**	**Mon 2/27/17**	**Fri 4/28/17**	**$61,400.00**	
18	**1.6.3**	**Readout Electronics**	**223 days**	**Mon 10/3/16**	**Wed 8/9/17**	**$130,018.18**	
35	**1.6.4**	**Ancillary**	**60 days**	**Tue 10/18/16**	**Mon 1/9/17**	**$56,200.00**	
39	**1.6.5**	**Mechanics**	**276 days**	**Mon 10/3/16**	**Mon 10/23/17**	**$387,400.00**	
65	**1.7**	**Prototype Assembly**	**40 days**	**Thu 3/9/17**	**Wed 5/3/17**	**$20,800.00**	
69	1.8	Test Beam Operation	3 wks	Thu 10/5/17	Wed 10/25/17	$0.00	
70	**1.9**	**sPIT-DOE Final Review**	**14 days**	**Tue 10/24/17**	**Fri 11/10/17**	**$52,000.00**	
74	**1.10**	**Procurements**	**519 days**	**Mon 11/13/17**	**Thu 11/7/19**	**$2,008,480.00**	
75	1.10.1	Procure 58 Inner Staves	120 days	Mon 1/1/18	Fri 6/15/18	$823,400.00	
76	1.10.2	Procure 100 SamTec Cables	2 mons	Mon 11/13/17	Fri 1/5/18	$39,800.00	
77	1.10.3	Procure 58 Readout Units	2 mons	Mon 1/8/18	Fri 3/2/18	$287,800.00	
78	1.10.4	Procure Optical Links	2 mons	Mon 3/5/18	Fri 4/27/18	$48,800.00	
79	1.10.5	Procure 29 Common Readout Units	2 mons	Mon 4/30/18	Fri 6/22/18	$167,800.00	
80	1.10.6	Procure Ancillary Materials	2 mons	Mon 6/25/18	Fri 8/17/18	$72,800.00	
81	1.10.7	Procure Cooling Plant	2 mons	Mon 8/20/18	Fri 10/12/18	$129,800.00	
82	1.10.8	Procure assembly fixtures & jigs	60 days	Mon 10/15/18	Fri 1/4/19	$119,200.00	
83	1.10.9	Procure end wheels	64 days	Mon 1/7/19	Thu 4/4/19	$54,480.00	
84	1.10.10	Procure Cylindrical structural Shells	14 days	Fri 4/5/19	Wed 4/24/19	$15,480.00	
85	1.10.11	Procure Detector Half Barrels	14 days	Thu 4/25/19	Tue 5/14/19	$17,480.00	
86	1.10.12	Procure Service Half Barrels	32 days	Wed 5/15/19	Thu 6/27/19	$130,240.00	
87	1.10.13	Procure Detector and Service Half Barrels	15 days	Fri 6/28/19	Thu 7/18/19	$25,800.00	
88	1.10.14	Procure Two Half Support Structures	4 mons	Fri 7/19/19	Thu 11/7/19	$75,600.00	
89	**1.11**	**Assembly and Testing**	**205 days**	**Fri 11/8/19**	**Thu 8/20/20**	**$99,600.00**	
96	1.12	Installation	2 mons	Fri 8/21/20	Thu 10/15/20	$64,000.00	

“Buy Staves” #3

	WBS	Task Name
1	1	sPIT Project
2	1.1	Start Construction (CD-3)
3	1.2	ALICE Inner Barrel Construction
4	1.3	Start R&D LANL
5	1.4	Start R&D Other Institutions
6	1.5	Project Management
7	1.5.1	Project Manager
8	1.5.2	Mechanical Liason Engineer
9	1.5.3	Electronics Liason Engineer
10	1.6	Design & Prototyping
11	1.6.1	Readout Test Stand
15	1.6.2	Staves
18	1.6.3	Readout Electronics
35	1.6.4	Ancillary
39	1.6.5	Mechanics
65	1.7	Prototype Assembly
69	1.8	Test Beam Operation
70	1.9	sPIT-DOE Final Review
74	1.10	Procurements
75	1.10.1	Procure 58 Inner Staves
76	1.10.2	Procure 100 SamTec Cables
77	1.10.3	Procure 58 Readout Units
78	1.10.4	Procure Optical Links
79	1.10.5	Procure 29 Common Readout Units
80	1.10.6	Procure Ancillary Materials
81	1.10.7	Procure Cooling Plant
82	1.10.8	Procure assembly fixtures & jigs
83	1.10.9	Procure end wheels
84	1.10.10	Procure Cylindrical structural Shells
85	1.10.11	Procure Detector Half Barrels
86	1.10.12	Procure Service Half Barrels
87	1.10.13	Procure Detector and Service Half Barrels
88	1.10.14	Procure Two Half Support Structures
89	1.11	Assembly and Testing
96	1.12	Installation



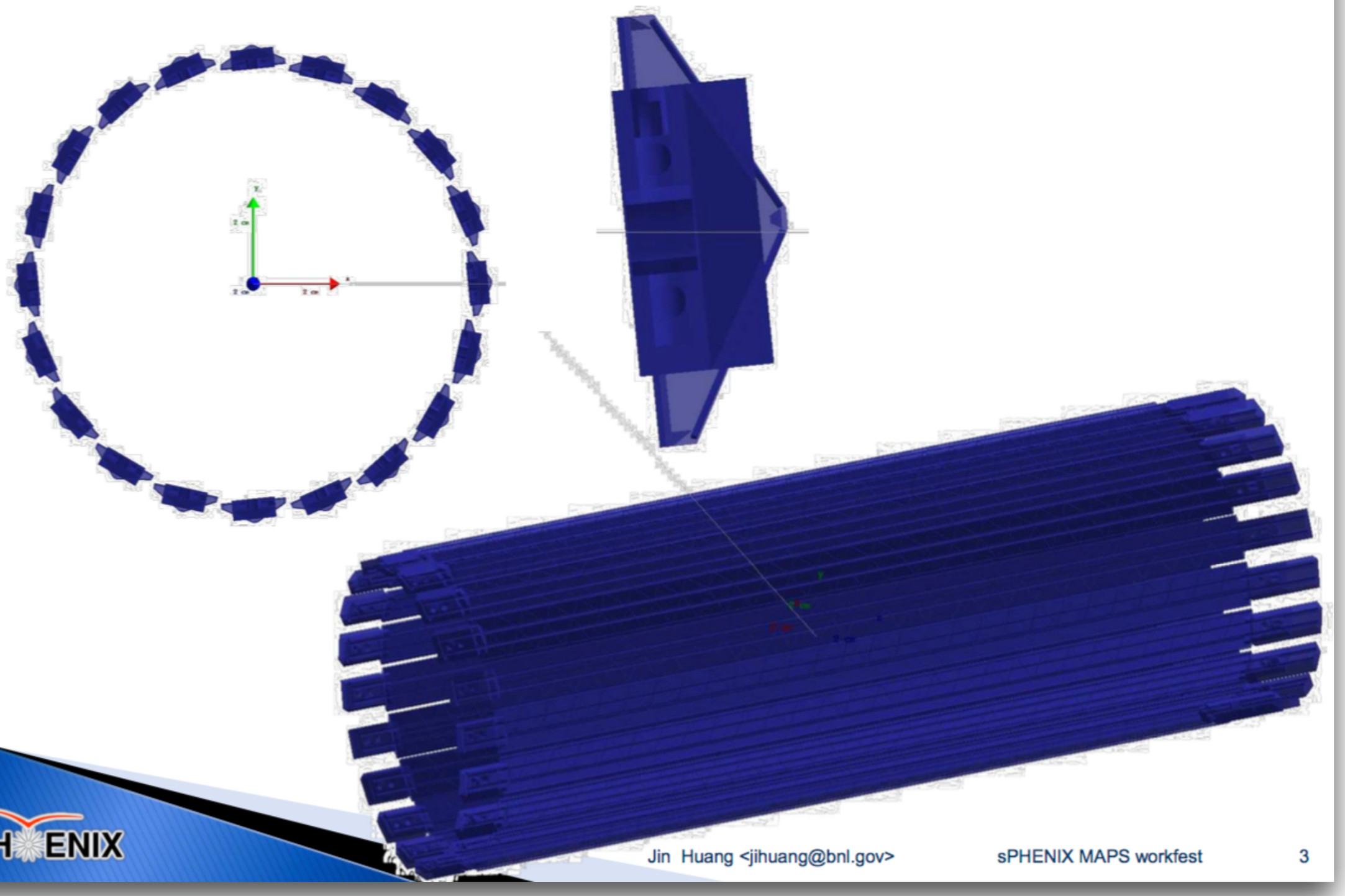
Run procurements in two parallel lines (detector hardware, mechanics & servicing)

Add more time for R&D on readout

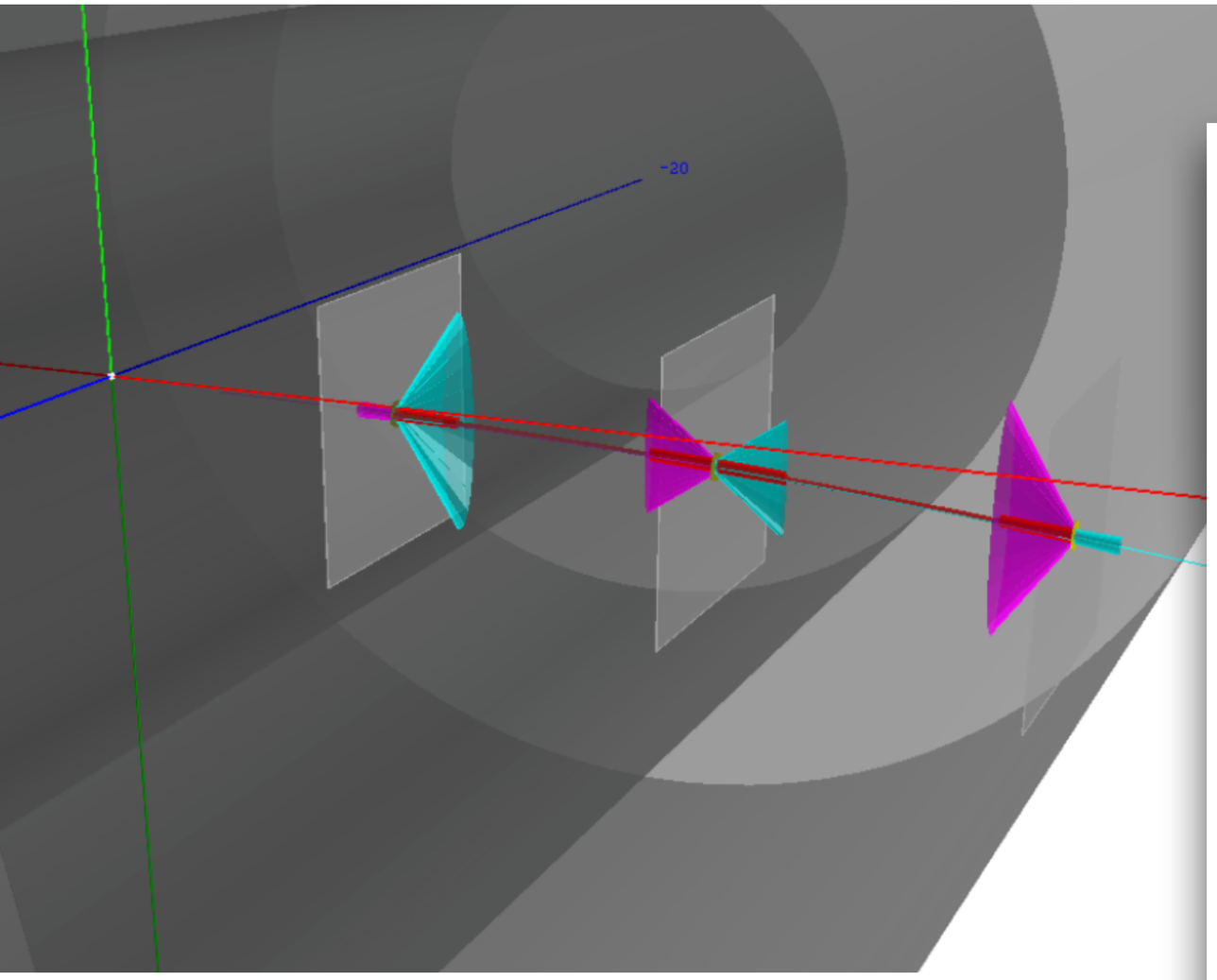
Contingency for custom readout boards (~$750k)

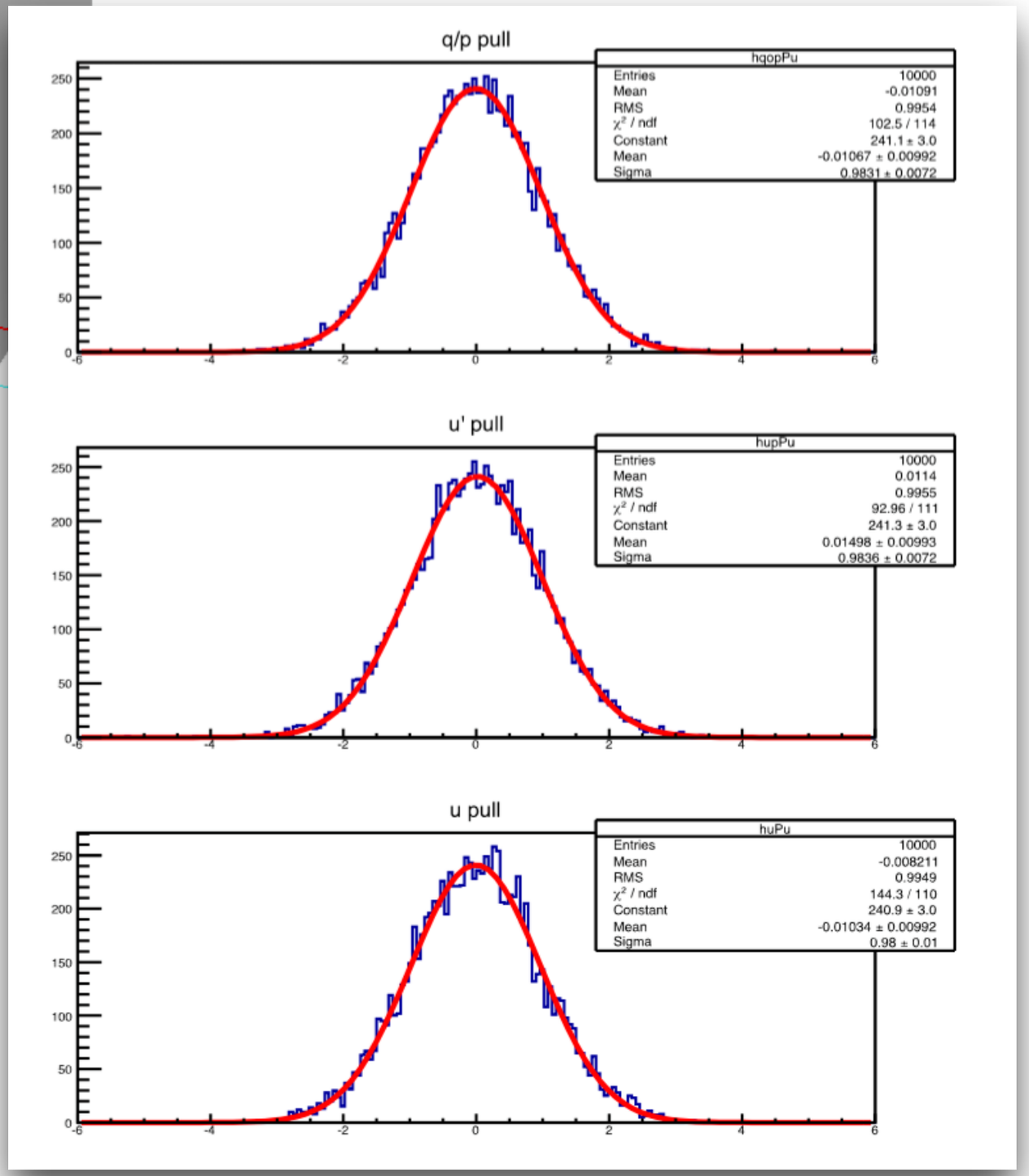
Simulations

Test assembly 20 staves in sPHENIX sim



Generic Kalman Code Progress





Critical Tracking Infrastructure coming thanks to Haiwang (NMSU)

Simulations

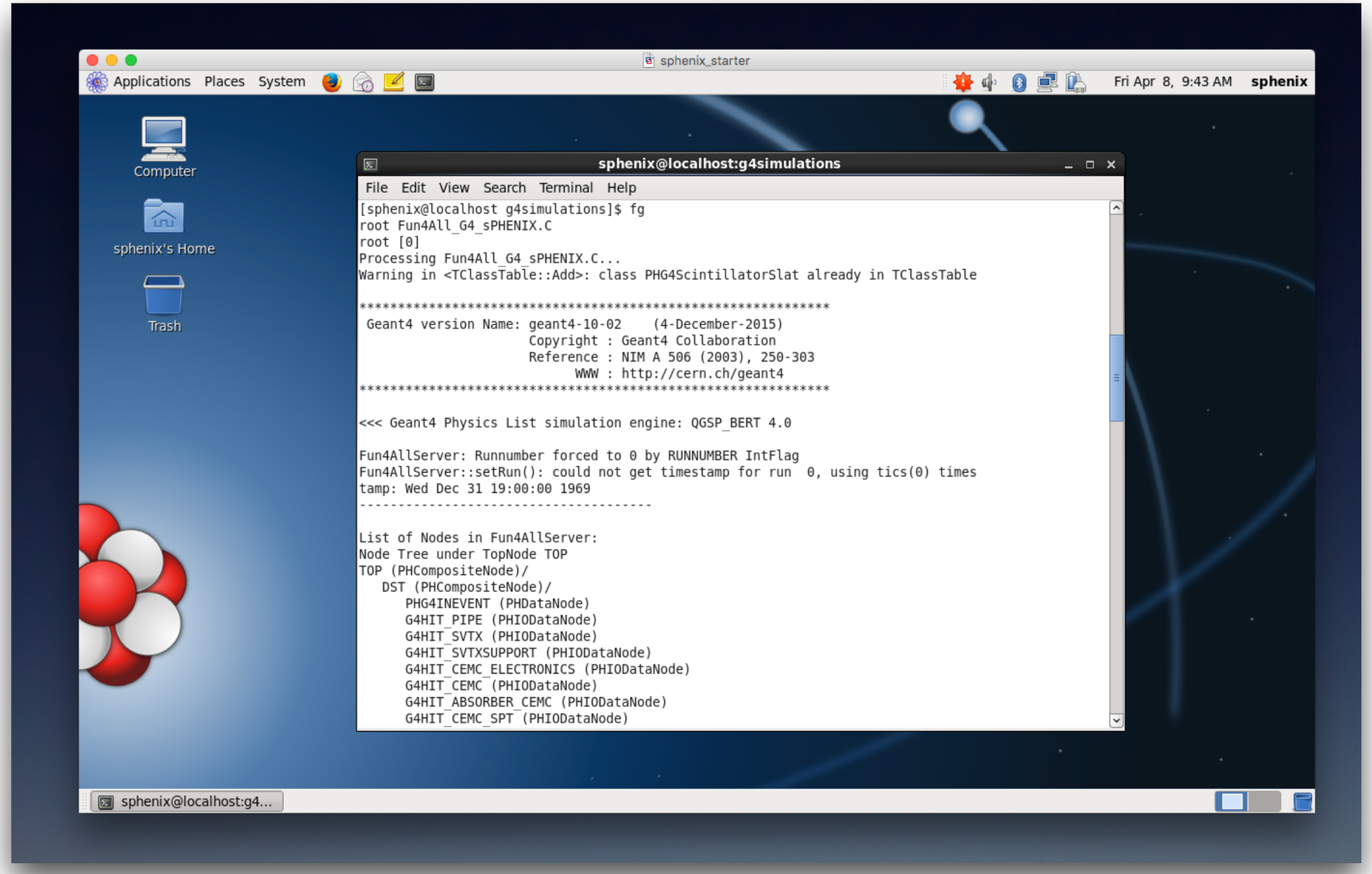
+ and lots of tutorial sessions that were very helpful to new people!

Next

1. Make it real code
2. Digitization
3. Geant geometry -> reconstruction exportation
4. Interface to pattern reco (sPHENIX Hough)
5. Fit via GenFit2 (Haiwang)
6. RAVE (Sanghoon)
7. Awesome B-jets plot ....

sPHENIX Starter VM

Download the sPHENIX environment (10GB) and push play:
https://www.phenix.bnl.gov/~mccumber/sphenixvm/



Roll your own or setup a computer in your lab:
https://www.phenix.bnl.gov/~mccumber/sphenixvm/setup

What's Next?

End of the workfest: "buy staves" file was ordered and loaded
Ballpark figure: $3-4M (under the $5M mark)
Schedule Consensus: "buy stave" option preferred, less sch. risk

My ambition to finalize in 3 days this week was thwarted:
Few day delay while obtaining MS Project (couldn't extend travel laptop checkout), new schedule is to do this next week

Finalize "buy staves" project file schedule, parallelize the procurements, add contingency for custom readout board design (plan to retire this risk under LDRD)

Then expand to the "build staves" option with details from Leo on the last day

Shop around for more collaborators
Develop additional funding paths

One More Thing…

LDRD Full Proposal Call

Good news! We've pass the first cut! Some excerpts from the feedback:

> "This proposal will build a new b-quark tracking detector for the planned sPHENIX experiment. Impact is high, since you can't have b-quark physics program without a b-quark tracking detector. End of project plan is to have a prototype detector, scalable to sPHENIX."

- Clearly an essential element of sPhenix.
- Theory effort is strong and in support of experimental effort.
- Studying the QGP is one of the major Nuclear Physics thrusts, and is of the highest priority in DOE/NP, and the community.

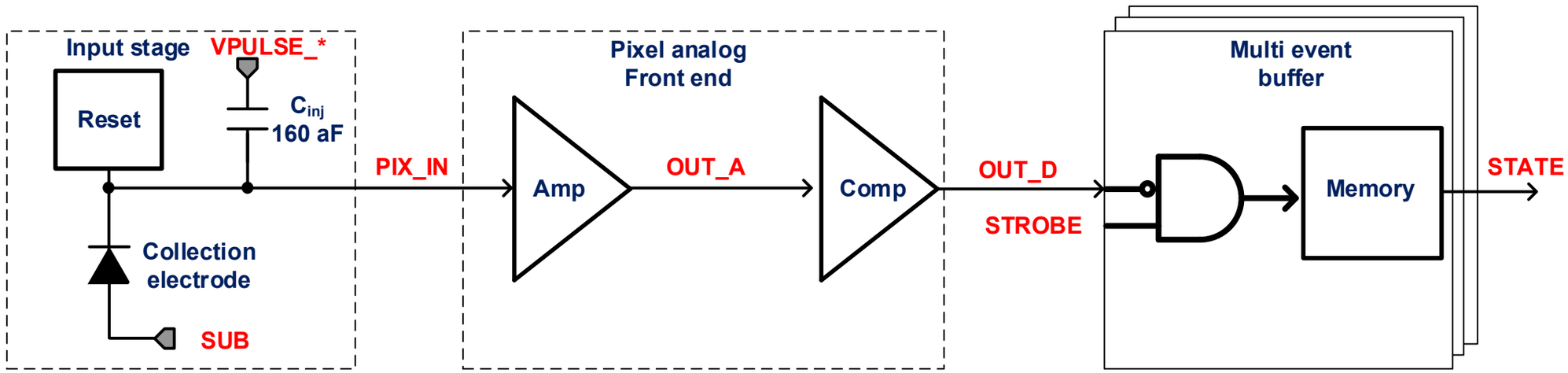
"This DR is well aligned for this timeline, and if pushed off to future years, could be a lost opportunity."
~ Review Committee

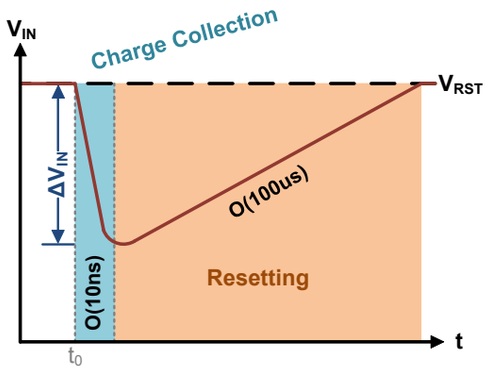
Full proposal due on May 12th
Expect an oral defense date May 31-June7th
1st internal strategy meeting: yesterday

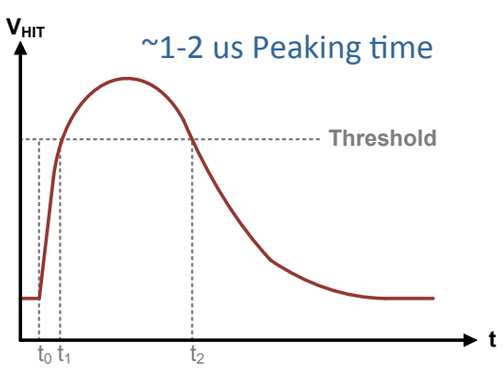
In other news: Moving in to a new lab space on Monday
Computers arrived and being setup, Small fund allocated for ancillary items, starting those purchases now.

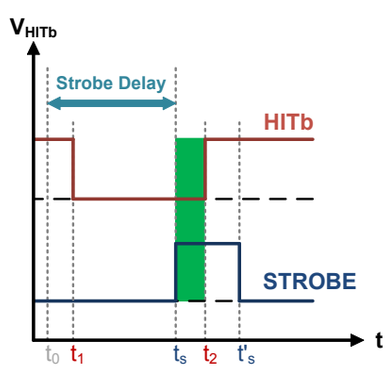
Backup Slides

ALPIDE Operation







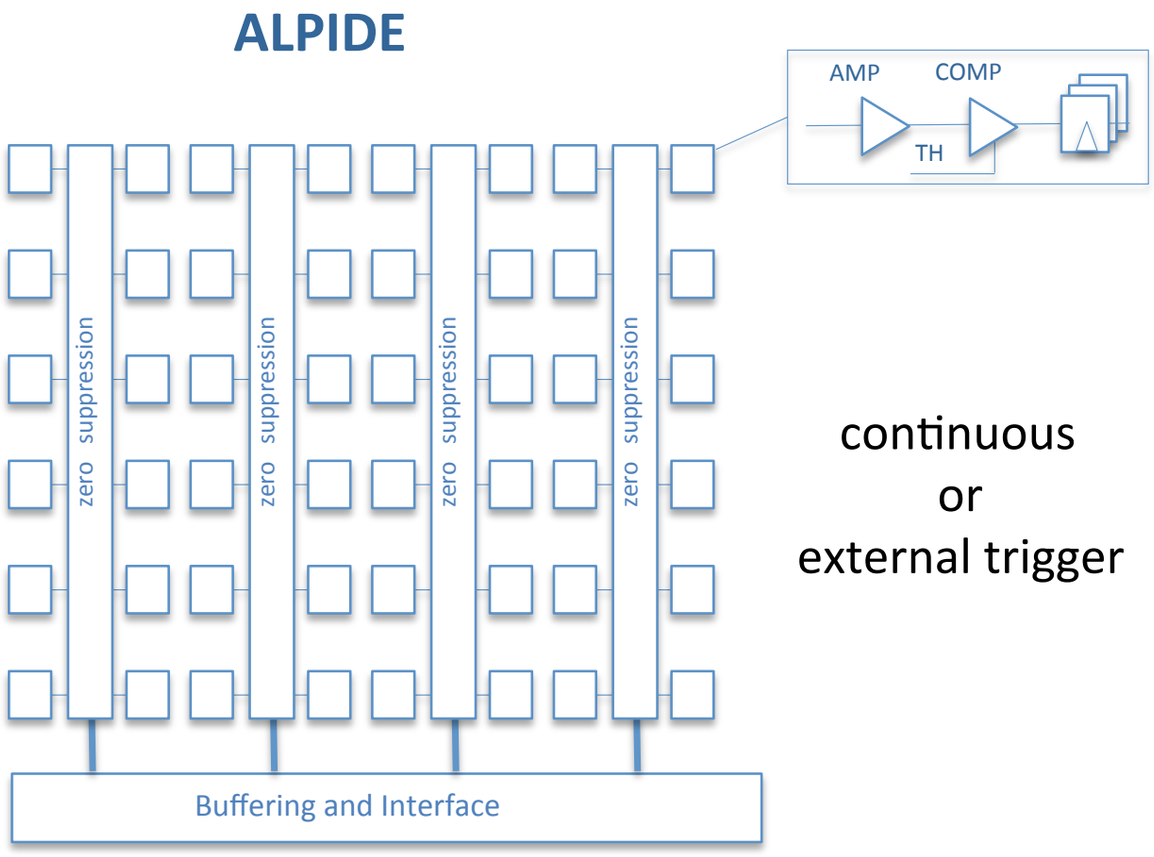


ultra low-power front-end circuit
40nW / pixel

Front-end acts as delay line

- Sensor and front-end continuously active
- Upon particle hit front-end forms a pulse with ~1-2μs peaking time
- Threshold is applied to form binary pulse
- Hit is latched into a (3-bit) memory if strobe is applied during binary pulse

ALPIDE Readout



continuous
or
external trigger

Architecture

- In-pixel amplification
- In-pixel discrimination
- In-pixel (multi-) hit buffer
- In-matrix sparsification

Key Features

- 28 μm x 28 mm pixel pitch
- Continuously active, ultra-low power front-end (40nW/pixel)
- No clock propagation to the matrix ➔ ultra-low power matrix readout (2mW whole chip)
- Global shutter (<10μs): triggered acquisition or continuous